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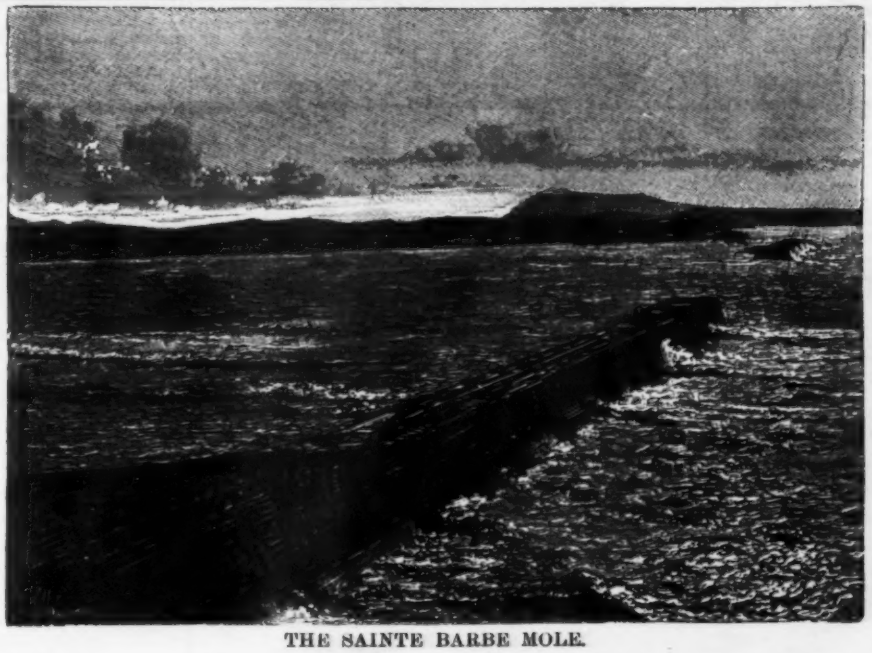
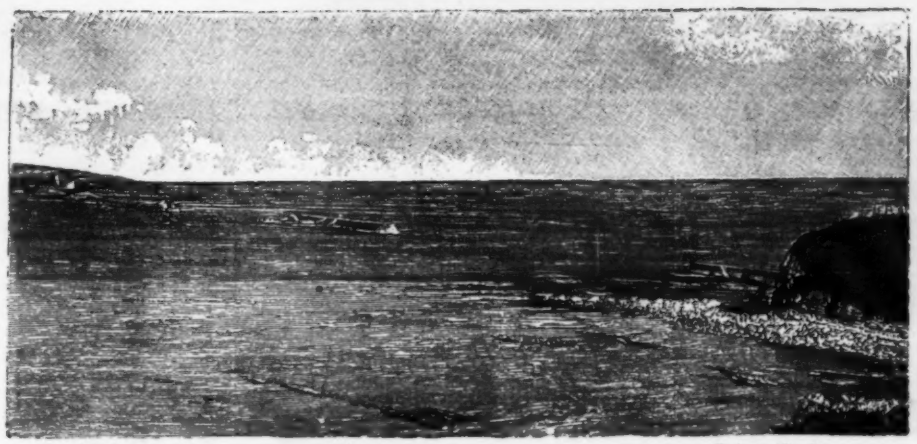
THE MOLES OF SAINT-JEAN-DE-LUZ.

MAN'S fierce battle with the ocean is not of yesterday. The angry sea precipitates its furious waves upon the terrestrial shores, undermines them, disaggregates them, and gradually swallows them up. How many villages, forests, and wastes have thus disappeared. The list would be a long one of those disasters which, like disasters of all kinds, whether in the political, economical, or social order, were catastrophes at the moment that they occurred, but appear at the present time only like little incidents in the forward march of humanity. How many of such catastrophes there are of which scarcely any traces remain, and how many of which no recollection even any longer exists. The face of the world is incessantly modifying, and all the efforts of man are powerless to prevent this inevitable transformation. But he can at least retard it, regulate it, and cause it to take place uniformly and without carrying irreparable ruin with it. To such invasion of the oceans, inertia and resignation was for a long time opposed. But a day came on which man, until then mute and powerless before these continuously renewed disasters, was roused at seeing his patrimony becoming exhausted, and thereafter applied his genius to reconquering, inch by inch, what the sea had stolen from him. Such is the case with Saint-Jean-de-Luz, whose port, protected in days of old by natural dikes, had nothing to fear from the terrible tempests of the offing. But, alas! rocks, like all things else, have their day, and those that served as breakwaters, incessantly lashed by the mad waves, and honeycombed and reduced to powder, so to speak, receded every century before the conquering billows. Thus it was that, tired of resisting, the points of Socoa and Sainte Barbe and the rock of Artha disappeared. After that, says Leonce Goyetche, the sea suddenly crossed its shores and marched to the assault of the village. Its incessant progress upon the beach and the disorder that it brought about in the regions of the bar and port finished the work of decadence begun by emigration.



THE SAINTE BARBE MOLE.

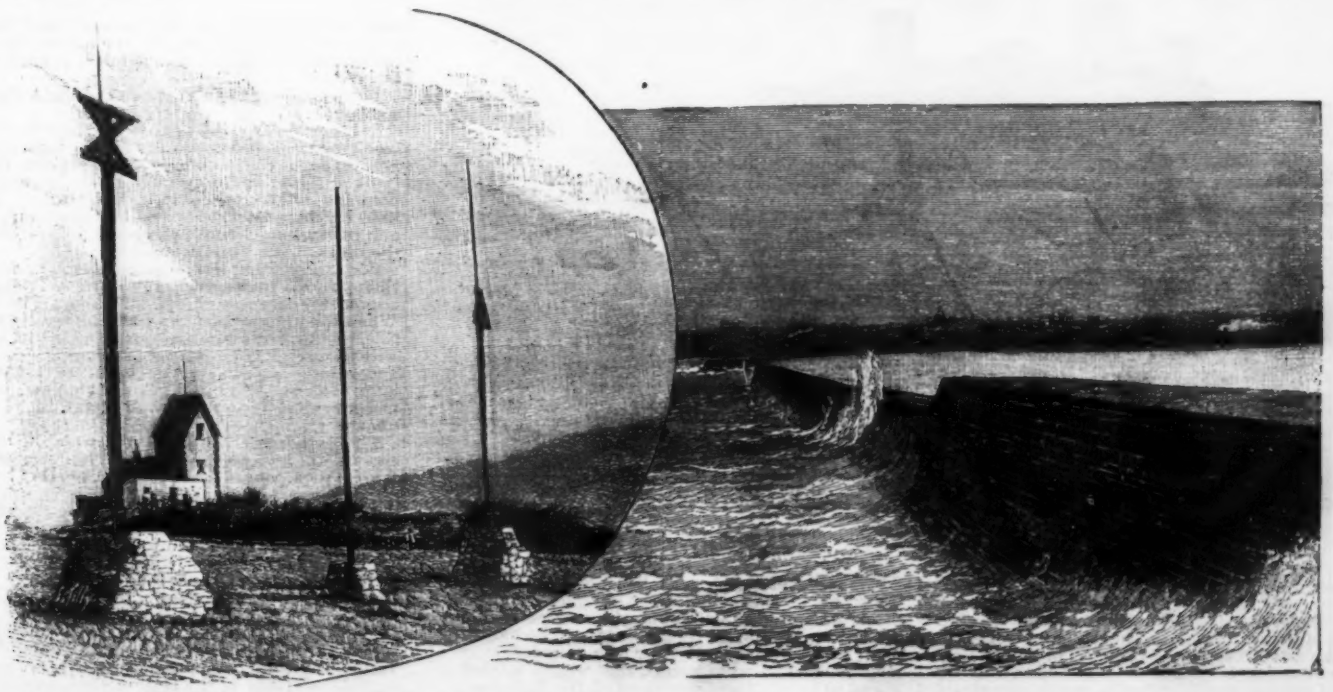


Socoa. Artha. Sainte Barbe.

GENERAL VIEW OF THE THREE MOLES.

This required a prompt solution, and the suppliant and earnest complaints of the unfortunate inhabitants made themselves heard. Unfortunately, as too often happens, the sinews of war failed for a long time, and the few works begun under the direction of Vauban, insufficiently consolidated, were carried away by tempests. Saint-Jean-de-Luz was given up without defense to the fury of the waves, buildings went to pieces and entire streets of the village disappeared. Since then, this lamentable state of things has been remedied by the construction of three huge moles, only two of which are finished, that of Socoa and that of Sainte Barbe. The foundations of the Artha mole, begun in 1867, are completed. The wall, which will be 250 meters in length, was begun in 1879. It is at present in a very advanced state, and will probably be finished this year. That will be the crowning point of this gigantic work.

But it has not been without great difficulty that one has succeeded in constructing this mole, for, besides the brief time that the sea affords the laborers, it happens also that it carries away the supply of materials, and sometimes even demolishes the newly constructed masonry. Thus, in 1884, after a heavy storm, a stretch of wall of about 500 cubic meters was detached and carried from the interior



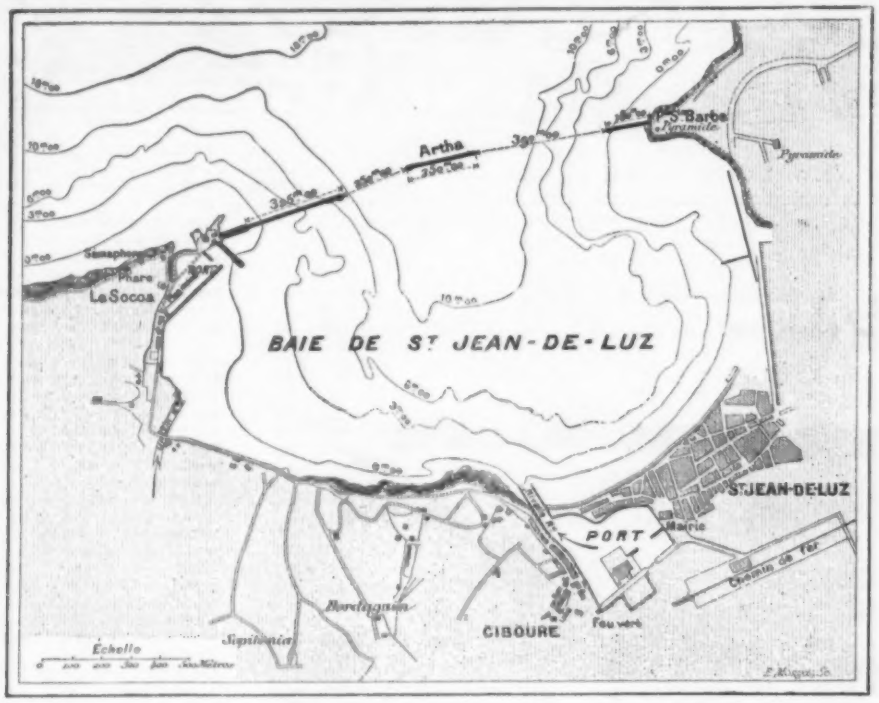
STAFFS SERVING TO GIVE THE ALIGNMENT FOR THE SUBMERSION OF THE BLOCKS.

THE SOCOA MOLE.

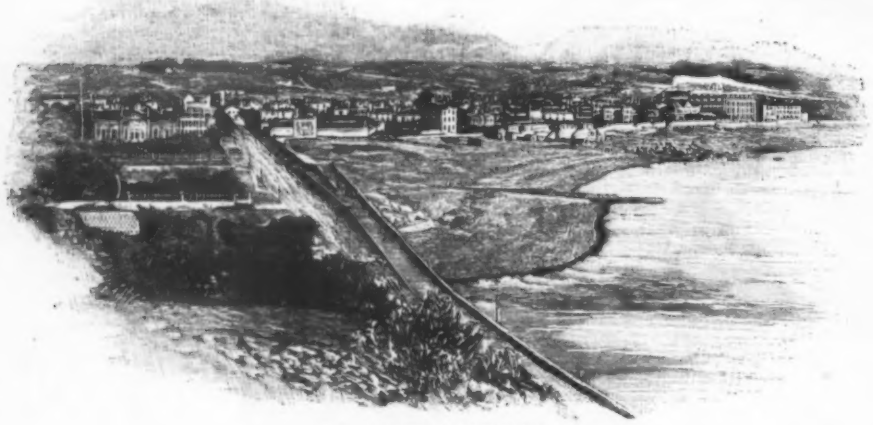
side of the mole. This mole, as well as the greater part of that of Socoa, rests upon large blocks of masonry, the manufacture, carriage, and submersion of which present interesting peculiarities that it is well not to pass over in silence.

The great works of the roadstead of Saint-Jean-de-Luz comprise not only the three moles mentioned above, but also a number of others that are rather wharf walls than moles properly so called. Such, for example, is the wall that extends along the beach of Saint Jean at the very foot of the hill of Sainte Barbe. The stone employed for all this work comes from what are called the Acherichila quarries, which are situated in the commune of Urrugne, near the line from Bordeaux to Irun and at about a kilometer from the Socoa field of operations.

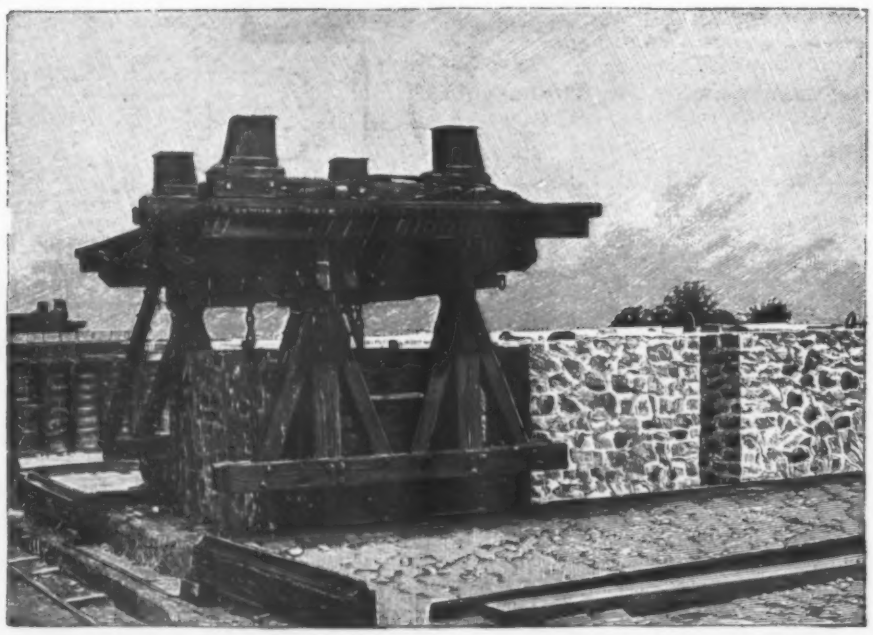
The materials taken from these quarries are carried by railway to the different working points. Those designed for the construction of the Artha wall are loaded upon pontoons by means of steam cranes placed upon the wharves of Socoa port and belonging to the administration of bridges and highways.



PLAN OF THE WORKS OF THE BAY OF SAINT-JEAN-DE-LUZ.



SAINT-JEAN-DE-LUZ.



APPARATUS FOR LIFTING THE BLOCKS.

The other materials are taken directly to the working points of Socoa and serve for constructing large blocks of rubble and of beton with slow-setting cement derived from the Boulogne works. Blocks of two sizes have been adopted for the foundation of the moles, 20 and 25 cubic meters, that weigh, respectively, 30 and 60 tons. The dimensions of the first are as follows: Length, 4 meters; width, 2·5 meters; and height, 2 meters; and those of the second are: Length, 4 meters; width, 2·77 meters; and height, 2 meters. The rubble blocks are constructed of ordinary masonry with a mortar composed of three parts of sand and one part of cement. The beton blocks are formed in moulds, and are composed of two volumes of square stone to one volume of mortar.

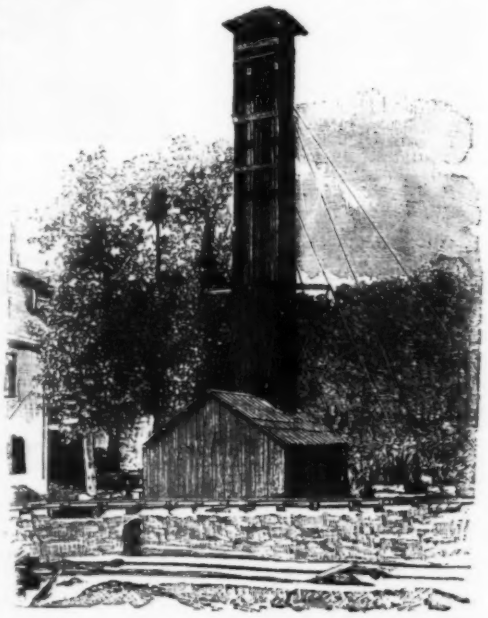
The lifting of the blocks is done by means of apparatus composed of four jacks, to the screws of which are adapted two chains that pass around the block. These jacks rest upon steel wheels that permit of making them roll upon a track of 4·9 meters gauge. They are established upon a wooden frame of great solidity, and are maneuvered with levers.

After the block has been raised 0·2 meter above the level of the ground it is made to descend by the frame or crane upon the track. As the latter has a slope of 3 centimeters to the meter, care is taken to moderate the descent by holding back the apparatus with a rope fixed at some point or other back of the block to be carried. The block is afterward deposited upon a trolley placed upon a track of ordinary gauge (1·445 m.), between two beams surmounted by rails that form a continuation of the track upon which the apparatus descends.

The loading of the block effected, the frame is replaced upon the track, the beams are removed and a locomotive pushes the trolley up to the summit of an inclined plane situated in the port of Socoa. The placing of the block upon the inclined plane is done by means of an apparatus composed of a windlass and a triple pulley, one of the blocks of which is fixed to the summit of two uprights 18 meters in height. In the center of this frame slides a counterpoise of 3,600 kilogrammes attached to the last block. A steel cable 24 millimeters in diameter winds around the drum of the windlass and retains the trolley after passing over a return pulley. The trolley, once started, causes the counterpoise to rise in its guides. It is stopped upon the inclined plane by a brake, forming part of the windlass, at such a height that coupled pontoons may seize the block with a hook and click through two eyes of iron wire inserted in the block.

This operation finished, the brake is loosened, and the trolley then continues its motion and enters a masonry trench, while the block remains suspended from the pontoons.

The counterpoise, which ascended during the descent of the block, slowly descends and causes the trolley to remount, empty, to the top of the inclined plane, whence the locomotive takes it back to get another load.



APPARATUS FOR LOWERING AND RAISING THE TROLLEY CARRYING THE BLOCKS.

The loaded pontoons are towed to the Artha mole by a steamer.

In order, during the trip, to prevent the fall of the block into the channel (an accident that might happen through the parting of a suspension chain), the block is seized by two safety chains fastened to the pontoons. After the block has reached the point fixed for its submersion, the safety chains are removed, and the system of hooks employed to this effect permit the block to drop instantaneously.

For constructing the foundations of the Artha mole, there were submerged large artificial blocks upon alignments determined by staffs planted in the earth. When the foundations reached the level of the lowest tide, the upper surface was regulated as well as possible with natural blocks—stones of about 900 kilogrammes and rubble inserted in the vacuities formed by the large blocks. Then, profiting by low water, the masonry that forms the wall of the mole was built above.

The foundations of the Artha mole are formed exclusively of large blocks, and are established upon the Artha rock, whose summit was at the level + 6·5 above the zero of low water. The height of the foundation at the other points varies up to 15 meters.

The Socoa mole is constructed upon the rock for the part anterior to this century, and for the prolongation begun in 1857 upon a foundation formed of large blocks like those of the Artha mole.

The Sainte Barbe mole is built directly upon the rock.

These gigantic works, begun nearly forty years ago, have cost no less than six and a half million francs. They have until the present admirably resisted the terrible tempests of the Gulf of Gascogne—those tempests that easily displace the huge mass of blocks forming the foundation of the moles, and which, in 1882, for a length of 149 meters, and without a vestige

of it being found thereafter, carried away a wharf 10 meters in height, 15 meters in width at its base, and protected by a triple row of piles.

It only remains for us to congratulate the engineers for having brought to a successful conclusion a work so full of difficulty, and also to congratulate all their

PONTOONS FOR CARRYING THE BLOCKS.

fellow laborers, great and small, who have not feared to confront a real peril in order to preserve their fellow citizens from the disasters of the invading waves.

Let us, then, wish a long life to these simple walls, which, seen from afar, resemble merely three insignificant black dots, but the destruction of which would prove the speedy ruin not only of Saint-Jean-de-Luz and Ciboure, but also of the numerous villas that the lovers of nature have erected in the vicinity.—*L'Illustration.*

TREVITHICK'S HISTORIC BOILER.

AMONG the objects of extreme mechanical interest at the Chicago Exposition is an original iron boiler of one of Trevithick's high-pressure engines, of which several were made, and used principally for thrashing purposes in or about the year 1812. *Engineering* says: They were rated at about 4 horse power, with a moderate steam pressure. They were without safety valves, steam and water gauges or feed pump, and would run about six hours without requiring a further supply of feed; then the steam was blown off and the boiler refilled for another run. The engine was on the direct single-acting high-pressure principle, with an open top cylinder resting on and mostly within the boiler. The steam was distributed by a three-way cock operated by an eccentric on the crankshaft, which had a loaded flywheel to assist the return stroke. These engines were sometimes, for the sake of economy, fitted with an expansion cock worked by a cam with an early cut-off. It is stated that when so fitted these engines consumed only 2½ lb. of coal per horse power hour. This engine required very little attention; a farm laborer could easily regulate it. The original cost was about £80. A wood model of the cylinder of this engine accompanies the boiler. Some of these engines continued in use for more than fifty years, and required but little repair. Two drawings accompany this exhibit, one being a general arrangement of the engine and boiler, and the other being a detailed drawing of the cylinder and boiler in section. These are reproduced (Figs. 1, 2 and 3), and with the perspective view (Fig. 4) clearly show the construction of this interesting prime mover.

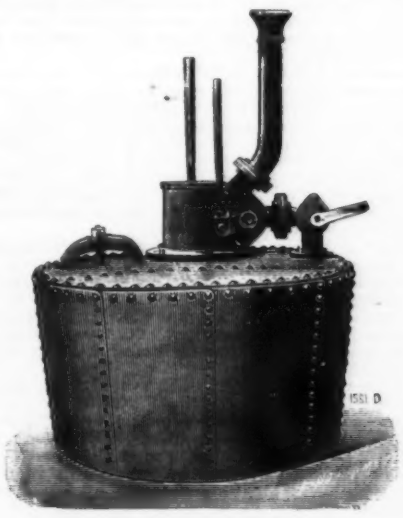
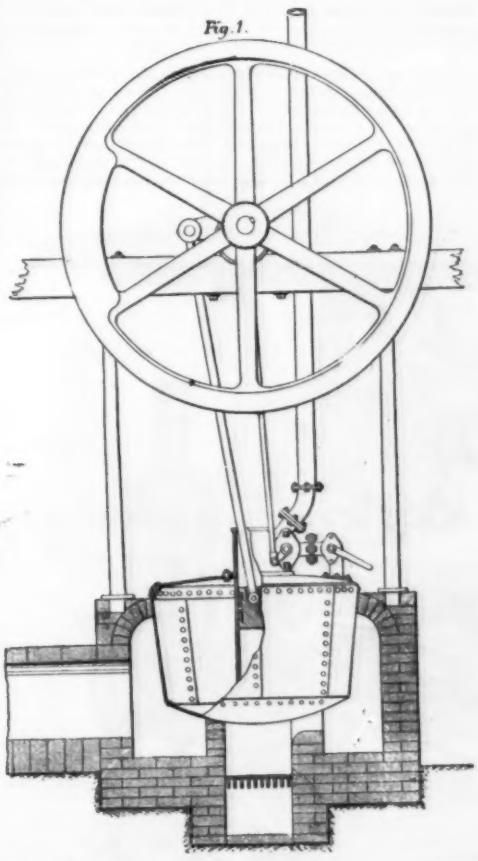
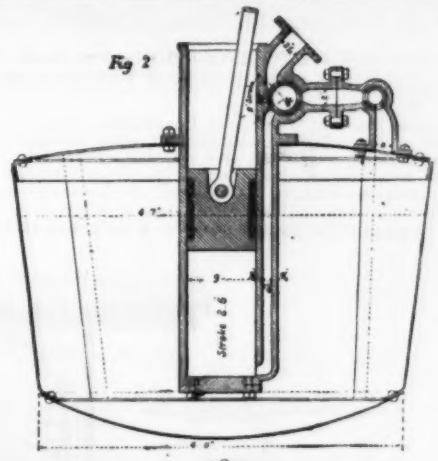
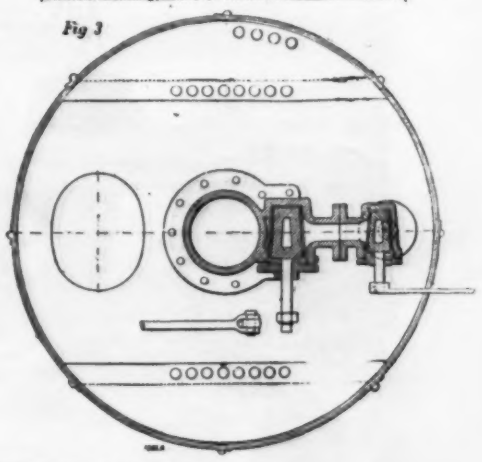


FIG. 4.







THE WORLD'S COLUMBIAN EXPOSITION—TREVITHICK'S BOILER.

BOYNTON BICYCLE ROAD.

THE members of the Thomson Scientific Society, of Lynn, recently entertained Hon. E. Moody Boynton, who talked to the members about his bicycle railway and its operation by electricity.

The question of questions at the present day is rapid transportation, said Mr. Boynton. Economy is secured by water routes, where the cost is seldom more than one mill a ton per mile, but the demand for more rapid transportation seriously threatens the supremacy of the water routes. To-day Boston and the principal cities of Europe and America are as devoid of rapid transit as Egypt at the dawn of civilization. The light engine of Ericsson and Stephenson, which could run as fast as the average train now runs, has been increased in weight until we carry 20 pounds of timber and iron in palace cars and 10 pounds in crowded ordinary cars to every pound of paying weight of passengers carried. On long routes across the continent the weight and waste are so enormous that national railroad bankruptcy is threatened, unless the present extravagant system is changed. But in order to keep the track at high speed efficiency and to obtain the necessary boiler and engine power, weight has been increased, rails, bridges and roadbeds made heavier, until all the great thoroughfares are capitalized so heavily that they can be paralleled at one-tenth their cost and entirely swept away by electric rapid transit.

The capital of the railroads of the United States many times exceeds that of the national and savings banks. Any impairment will bring on a financial convulsion and possibly a revolution. I believe that the controllers are conscious that a great change is pending. These roads are banded together and all individual building of steam railroads has ceased. The use of the single rail for the passage of trains on standard gauge railways has been my especial study. We constructed near New York an experimental railroad out of an abandoned standard gauge road, so that no practical engineering should go without attention. It was an old surface road elevated for one mile and surface for three-quarters of a mile. The curves were so many that it had been abandoned and stage coaches substituted. At an expense of $100,000 we repaired it and equipped it with my single rail bicycle engines and cars, and in three years we have run 27,000 trains, carried 100,000 passengers safely, smoothly and at three times the speed of standard gauge engines. With an expenditure of five pounds of coal per mile we move three cars containing seats for 324 passengers. I used veneer and steel in the construction of the cars, each of which contains 18 compartments seating six persons each. They are entered from the side like a hack. One brakeman opens and closes the doors of two cars by a lever without leaving his position. Not an accident of any kind has taken place in the three years. These cars are stiffer and stronger than any others, on account of their compartments and special construction with steel and veneers. Where the sheets of the veneer come together in the compartments no strain is observed in stopping the train when running 70 miles an hour. There has been scarcely any wear and tear of the working parts when rounding the sharpest curves. Electricity should be used. If electric energy from coal is between 40 and 50 per cent. if applied electrically, and 80 per cent. by steam, the difference will be more than made up by the saving in weight. My largest engine contains an eight-foot driving wheel with a 14 inch stroke. Nearly two strokes are made to the present ordinary 11 ton engine's one. My first bicycle electric motor car has wheels five feet in diameter, turning on spindles, one at each end of the car, which is sharpened to cleave the atmosphere. The field and armature are in and on the wheel, and it can turn the sharpest curve. If a road of sufficient length were completed the first motor could run at the rate of 200 miles per hour.

TAIL SHAFT PRESERVER.

MR. T. MUDD, of the Central Marine Engine Works, West Hartlepool, has recently fitted to the propeller shafts of several steamers engined at these works an arrangement for preventing the galvanic action which arises immediately at the ends of brass liners when immersed in water, and the general corrosive action that proceeds along the middle part of the shaft between the liners when exposed to salt water in the stern tube, and which is aggravated by the churning action produced resulting in the water being largely mixed with atmospheric air. Mr. Mudd holds that the one great essential to be aimed at is keeping the water away from the shaft. This has been attempted in several ways, such as by lengthening out the liners till they meet, and there brazing them together, but he believes it has never been effectually accomplished, and the covering of a shaft with brass all over is a very expensive expedient. Mr. Mudd's patent tail shaft preserver then consists simply of a tube or sleeve, made of first-class indiarubber, of such dimensions as to cling tightly to the shaft over the whole length between the liners, and for several inches up the inclined liners at its ends.

For this purpose the liners are lengthened out about 6 in. more than is usual, and gradually tapered away to accommodate the elastic sleeve. This gentle tapering of the liners has another good effect, as it gradually diminishes the strength of the liner, and so overcomes the objection to a sudden change of strength where the liner finishes, and which, doubtless, in many cases aggravates the damage caused by galvanic action at that point. When the preserver is to be put on the shaft, the latter is thoroughly cleaned bright, and coated with a suitable cement, and by means of special apparatus of a simple character the sleeve is drawn over the end of the shaft until it is in its place, where it becomes embedded firmly in the cement, clinging so tightly as to make the accession of water beneath it quite impossible. When desired, the ends may be lashed with copper wire over wire gauze, and the lashings soldered together. To prevent any chance of the sleeve being damaged when the shaft is being pushed into its place in the tube, a false nut is provided which runs on the thread on the end of the shaft, the external diameter of which is precisely the same as the diameter of the brass liners, and which therefore holds up the point of the shaft as it passes through, preventing the elastic tube from being injured by the neck bush. This nut, of course, goes with the ship as part of the outfit.

PETROLEUM ENGINE EXHIBITS AT THE WORLD'S COLUMBIAN EXPOSITION.

AMONG the interesting exhibits in the German department at the great Exposition in Chicago are some elegant specimens of engines operated by petroleum only, no steam boilers being used. They are from the famous establishment of Grob & Co., at Leipzig-Eutritzsch. The petroleum is heated and converted into gas, so that the machines are, practically, gas engines. A machine of this kind is shown in the annexed engravings, in which Fig. 1 gives the general appearance of the stationary type; Fig. 2 shows a portable engine applied to wood sawing and splitting; and Fig. 3 shows a launch propelled by a 4 horse power Grob oil engine.

The power in these engines is generated by means of common kerosene oil such as is burned in lamps. This oil is atomized, gasified, mixed with a proper proportion of air, compressed and ignited behind a piston, producing the pressure necessary to propel the piston and parts connected therewith. The speed of the engine is regulated by varying the supply of oil. The ordinary speed is from 250 to 400 revolutions per minute, according to the size of the engine, but an attachment is provided by which the speed can be reduced to 150 revolutions per minute. These engines range from ½ horse power to 30 horse power. We understand that further preparations are being made for making larger sizes. The engine occupies very little floor space, as will be seen by reference to Fig. 1; and where the machine is designed for use as a portable engine, the engine and accessories are mounted on a platform wagon. The amount of oil consumed in engines of the larger size is about a pint per horse power per hour: for smaller engines, about a pint and a half per horse power per hour.

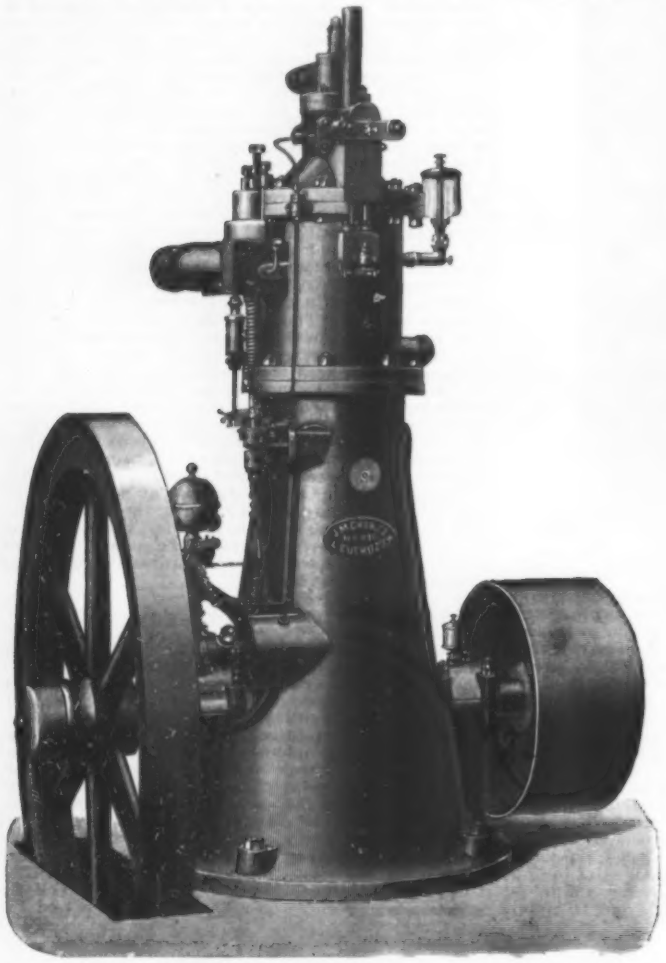
Messrs. Grob & Co. claim to have been the pioneers in the construction of oil engines, and they have at Leipzig the largest oil engine factory in Europe. This engine is now being introduced into this country, and a number of them are on exhibition at the Columbian Exposition in Chicago, in Section F, No. 1,526.

The exhibit consists of 1 horse power, 2, 6, 8 and 10 horse power petroleum motors, a 2 horse power gas motor, a 4 horse power portable engine and one 6 horse power petroleum motor launch.

These engines are to be used for any purpose and in any place where a gas engine is applicable, also in places where gas is not obtainable and where steam is not allowable. Besides the economy in fuel, there is also great economy in attendance, as the engine requires no special engineer, and it is self-regulating in all respects, so that it runs for hours without any attention whatever.

Besides the uses already enumerated, it is specially applicable to small electric light plants, for pumping water and for driving the machinery used in small industries. It has also been applied to tramways, being put up in the form of a small dummy locomotive.

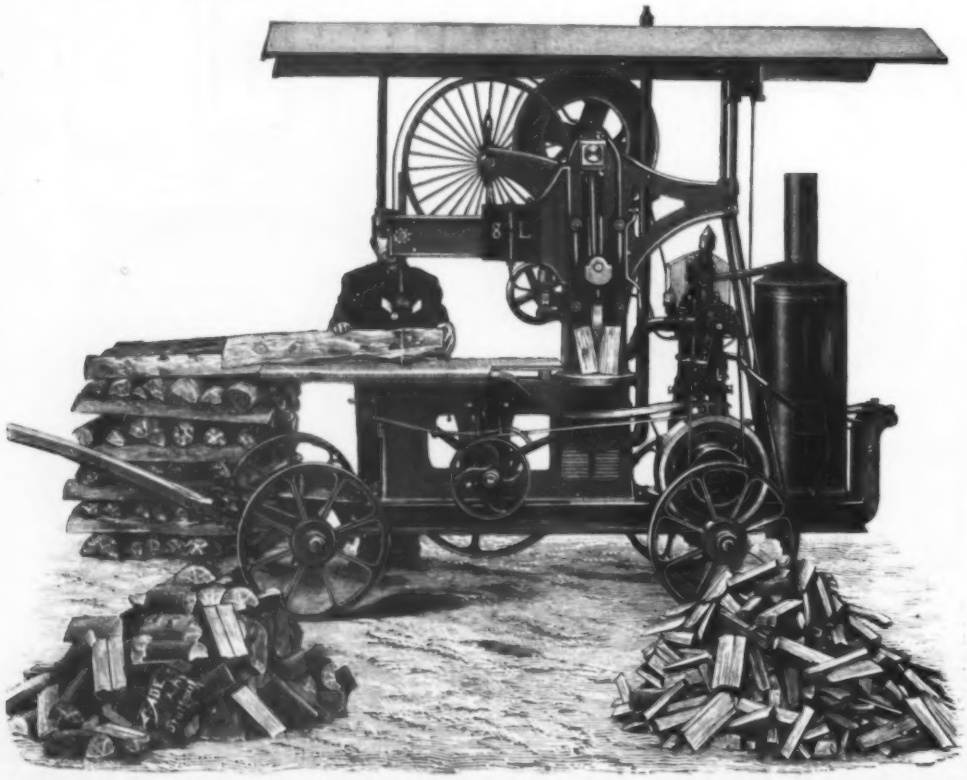
Further information may be obtained by addressing J. M. Grob & Co., manufacturers, Leipzig-Eutritzsch, Germany.



THE COLUMBIAN EXPOSITION.—FIG. 1.—J. M. GROB & CO.'S EIGHT HORSE POWER PETROLEUM MOTOR.

THE COLUMBIAN EXPOSITION.—FIG. 4.—FOUR HORSE POWER PETROLEUM MOTOR WAGON.

THE COLUMBIAN EXPOSITION.—FIG. 3.—BOAT PROPELLED BY A FOUR HORSE POWER PETROLEUM MOTOR.



THE COLUMBIAN EXPOSITION.—FIG. 2.—PORTABLE TWO HORSE POWER PETROLEUM MOTOR COMBINED WITH WOOD SAWING AND SPLITTING MACHINE.

NEW BRITISH WAR SHIPS.

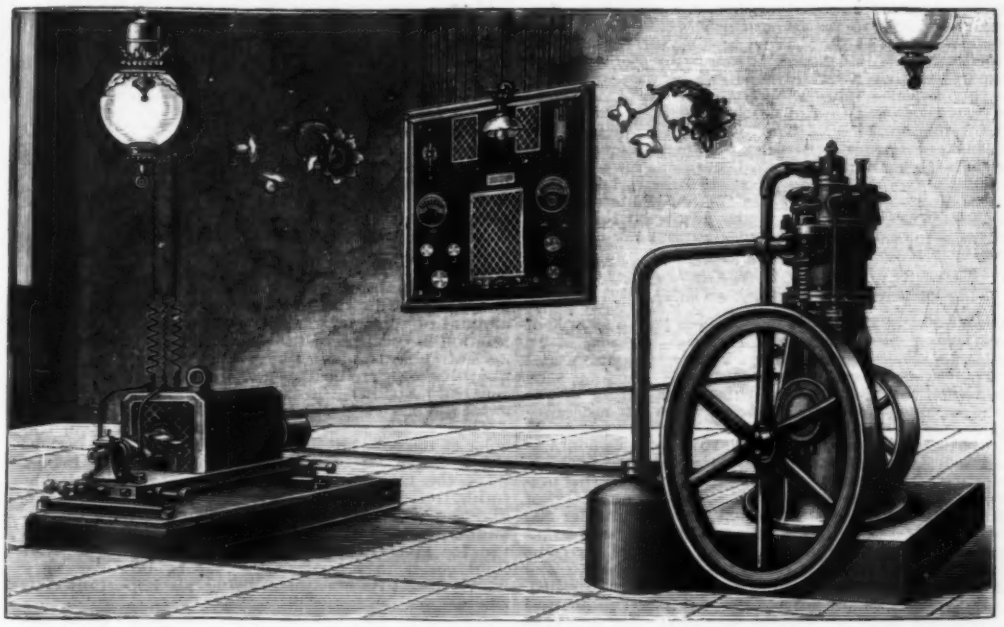
THE new first-class battle ship Empress of India, sister ship to the Royal Sovereign, and the last of the four completed battle ships of the same class, lately underwent her official trials off the Nore, lasting seven hours, when, with steam at a boiler pressure of 148·35 lb. per square inch, maintained with an air pressure of 0·51 in. of water, and a mean vacuum in the condensers of 29 in., the engines attained a mean speed—

of great regularity—of 96·2 revolutions per minute, and developed a total of 9,507·58 indicated horse power.

On a four hours' forced draught full power trial, the results were that with an inch of air pressure in the stokeholds an ample supply of steam at a boiler pressure of 150·77 lb. per square inch was easily maintained, the revolutions of the engines—which were remarkably uniform—reached a mean of 102 per minute, and the total indicated horse power developed by them was 11,625; the speed of the ship, tested by a continuous running log and taken at two-hour intervals, being 18 knots per hour throughout the trial, the mean draught of the ship at the time being 25 ft. 6 in. These trials give an excess in power developed over that contracted for of 507 indicated horse for the natural draught and 625 for the forced draught.

The principal dimensions of the Empress of India are the same as those of the Royal Sovereign and the Hood, being 380 ft. long between the perpendiculars, 75 ft. beam, and displacement at load draught 14,150 tons, but she and the Royal Sovereign differ from the Hood in being barbette ships, the latter being a turret ship. The armament of all the battle ships of the Royal Sovereign class is the same, and comprises four—two forward and two aft—67-ton guns, mounted *en barbette*, 13½ in. bore, firing a projectile of 1,250 lb., with a powder charge of 680 lb.; ten 6 in. 100-pounder quick-firing guns, four on the main deck and six on the upper deck; sixteen 6-pounder and nine 3-pounder quick-firing guns; two field guns, several machine—Maxim—guns, and seven torpedo tubes, two being submerged. In addition to her main armor belt on either side, 250 ft. long by 8½ ft. deep and 18 in. maximum thickness, the Empress of India, like the Royal Sovereign, has a secondary 4 in. steel protective belt 150 ft. long located amidships above the main belt.

The first-class protected cruiser, H. M. S. Endymion, 7,350 tons displacement, and twelve guns, was recently taken on her official trial trip, when a continuous run at full speed for eight hours was made in the English Channel, with the result that the engines indicated 10,646 horse power at 99·4 revolutions, with an air pressure equal to only 0·17 in. of water. The speed shown by the log was 21 knots, which is greatly in excess of what was anticipated, and the consumption of coal was also most satisfactory, being 1·6 lb. per indicated horse power per hour.



THE COLUMBIAN EXPOSITION.—FIG. 5.—THE PETROLEUM MOTOR APPLIED TO AN ELECTRIC LIGHT PLAN FOR A PRIVATE DWELLING.

SOLID SILVERWARE CHEAPER THAN PLATED.

A CORRESPONDENT of the *Engineering and Mining Journal* writes as follows:

The investigations of the mint put the consumption of silver in the arts (coinage value) as follows: In 1889, when the average price was 93 cents, value, $8,569,318. In 1890, with an average price of $1.06, value, $9,031,178. In 1891, with average price 98 cents, value, $9,031,746. In 1892, with average price 87 cents, value, $9,106,540.

It is surprising that the low price of silver has not, to a larger extent than seems to have been the case, stimulated its consumption in the arts. The production of the salts of silver, especially its nitrate, employed so extensively in photography, would not sensibly be affected by even a notable rise or decline in value, but not so the use of the metal itself. With a decline in silver from $1.29 to 83 cents the replacement of plated ware by sterling metal ought to be inevitable, and in this substitution we see the only reason why silver may not decline permanently much below its present figure, be its monetary status what it may. Manufacturers are slow to meet the altered value of a metal by reducing, even proportionately, the price of their manufactured wares, but of late the fact that silver has descended to a lower grade in the scale of metallic value, and will probably remain there, has evidently convinced some of the large silver manufacturers that a great reduction in the price of certain classes of silverwares should be made, and that, if made, the increased sales will compensate for the decreased profit on each ounce manufactured. The largest house on the Pacific, that of Shreve & Co., of San Francisco, now retails stamped silverware at $1.15 per ounce, and has sold out its entire stock of plated ware. The Eastern combination of silversmiths has fixed its retail price of similar goods at $1.60 per ounce. It is a fair presumption, however, that if one important house can sell at $1.15, that is a profitable price for wares upon which slight hand labor is expended.

Assuming, therefore, that when silver is at 83 cents forks and spoons and certain massive articles of table ware can be profitably sold at $1.15 per ounce, considerations of economy will make it more profitable to buy silver than to buy plated ware. Take, for instance, tablespoons. One dozen triple-plated spoons weigh 19¾ oz., and retail at $14.50 per dozen, which is $1.20 per spoon, or 73 cents per ounce. The same spoon, weighing 1·6 oz. troy, with silver at $1.15 per ounce, costs of sterling silver only $1.89. The actual silver in the spoon is 1·65 oz., less twenty per cent. alloy, equal to 1·32 oz.; value, at 83 cents, $1.09. On the white metal of the triple-plated tablespoon there is deposited only 1-12 oz. of silver, which, considering the cost of separation, has intrinsically no value and which, after ten years of service, begins to wear from the surfaces most exposed to abrasion. In buying, therefore, tablespoons to-day of plated ware, we pay $1.20 for the use of an article for say ten years. In buying a similar spoon of sterling silver we buy an article containing metal of the intrinsic value of $1.09 for $1.89. At the end of the ten years, when we assume the plated ware to have become tarnished, and, therefore, worthless, the silver spoon has lost, say, the same weight that is deposited on the plated ware, or about 8 per cent. of its weight, and is worth for its actual silver contents say $1, but as a spoon it is worth its original value of $1.89, less 9 cents for loss in weight of silver, or $1.80. Is the interest on the difference between what is paid originally for the two spoons greater or less than the value of the silver spoon at the end of the ten-year period?

The result answers the question whether it is actually economical to buy silver in preference to plated ware. The difference in the cost of the spoon to-day is 69 cents, which, deposited in a savings bank which gives 4 per cent. coumpound interest, would at the end of ten years yield $1.01, or exactly the value of the silver in the sterling spoon, but 79 cents less than the value of the spoon as a spoon. When the rate of interest was higher, and the difference between the value of manufactured and unmanufactured silver greater than at present, the balance of advantage was on the side of plated ware, as it still is if we estimate manufactured silver at $1.60 instead of $1.15 per ounce, for at that price our tablespoon costs $2.64 instead of $1.89, and the difference in the cost between it and the plated spoon is $1.44, which at the end of ten years would increase to $2.09, or 37 cents more than the value of the old spoon. It would seem, therefore, that apart from the considerations of risk and of taste, it is more economical to buy plated ware than silver, if silver sells at $1.60 per ounce, and more economical to buy sterling silver if it sells at $1.15 per ounce. The risk, of course, is a factor in most people's decisions, but so is the satisfaction of owning and displaying on your table silver with the sterling stamp. The gratification of our vanity may be considered as an offset to our fears, and the determining condition is then reduced to one of economy.

The figures quoted from the mint reports would seem to contradict the assumption that the arts will use the more the lower the price of silver falls; but, on the other hand, unless the price of the manufactured article declines to a certain point, economic considerations counteract the sentimental, and people will buy plated ware. Let, however, the price of sterling silver sink to that quoted by Shreve & Co., and economic principles combine with the sentimental, and the solid ware will replace the varnished. If we speculate on what the increased use would amount to, we are met by the fact that the 62,600,000 inhabitants of the United States used in the census year only $9,031,178, equal at the coinage value to about 7,000,000 ounces, or only one ounce to every 9 of the population. If we assume that one-half of that 7,000,000 ounces or 3,500,000 ounces was deposited, and that one ounce of silver covered 12 ounces of plated ware, then 42,000,000 ounces of plated ware entered the market. If one-half of this were replaced by pure silver, 21,000,000 ounces, less 20 per cent., or 16,800,000 ounces, would go into consumption as sterling silver. Add to this the silver which would still be deposited and the 3,500,000 ounces which we assume is used at present in making more costly silverware, and in the manufacture of salts of silver, and we have a total of about 20,000,000 ounces used in the arts, instead of 7,000,000 ounces. Let the fate of the Sherman Act be what it may, if we can absorb one-third of all the silver which our mines and works turn out in our households, the necessary silver coinage will absorb the balance and further depression in price need not be feared.

THE VOYSEY & HOSACK ROAD SCARIFIER.

RECENTLY we had an opportunity of inspecting a road-breaking machine or scarifier, which is being introduced by the Road-Breaking Company (Voysey & Hosack's patents), limited, 63 Cornhill, London, E. C., and also the work effected by it on the Kingston Road, Putney Heath, S. W. This machine, which is shown in the engraving below, attached to a 15-ton steam road roller made by Messrs. Aveling & Porter, is of neat and substantial construction, and possesses one or two novel features. It consists essentially of a strong but plain cast iron framework supported on two wheels, attached to brackets fixed on the frame of the engine, and in which is pivotally mounted an inner frame supporting a drum capable of revolving and fitted with a number of stamped steel teeth or cutters. The inner frame is pivotally mounted to allow of the adjustment of the depth of cut of the teeth, and when necessary for traveling purposes to raise them altogether free from the ground. The drum carrying the cutting teeth in the machine which we inspected is caused to revolve at a speed of about 60 revolutions per minute by means of chain gearing driven from a countershaft, which in turn is similarly driven from the main shaft of the engine. The weight of this machine is about 2 tons 12 cwt. It will "turn up" a width of road in one operation of about 30 inches, and will operate upon 4,000 to 5,000 square yards of road per day. The teeth in the drum—eighteen in number—are stamped out of steel, and are of diamond section. They require no smith's labor to manufacture

IMPROVED ROAD SCARIFIER—GENERAL VIEW OF MACHINE ATTACHED TO A STEAM ROAD ROLLER.

or sharpen, and are all held in position in the drum—into which they can be inserted in a very short time—by four long bolts. These teeth are used until worn down, and under average working conditions will turn up 3,000 square yards of road.

It is claimed for this machine that it can be equally well adapted to any existing roller or traction engine, effects a great saving of "metal," and is much more efficient and economical than hand labor. The machine works equally well backward or forward, and can be easily attached to a steam roller, and again detached, to allow the latter to be used in consolidating the material. One of these machines has been in use for some time on Kent roads, and has, we are informed, given excellent results.

NOTES ON SILK BLEACHING.

By S. J. PENTECOST, F.C.S.

WHILE much useful information on the subject of silk bleaching may be obtained from the few books which treat of silk dyeing, some of the statements made therein are either indefinite and misleading or in one or two cases positively erroneous. In the following notes, I propose to review some of the principal methods used, to compare and examine their efficiency, and to mention details of one or two processes more recently introduced.

Silk is composed of the yellow or white filaments which the silkworm spins about itself, when entering the chrysalis state. The thread issues from the caterpillar as a double fiber seen under the microscope as two smooth cylindrical filaments cemented together by the silk gum, and this it throws around itself to form the cocoon. As soon as completed these cocoons are collected and heated in ovens, or by steam to 130° F., to kill the pupæ or insects; should these burst in this process, they soil the silk and these cocoons are put on one side. The outside loose flossy silk—about 18 to 30 per cent. of the whole—is removed before steaming, and with the soiled cocoons is used for spun silk.

There are several varieties of silk which require more or less different treatment when bleached, and these may be conveniently divided as follows:

1. Cultivated silk { (1.) White and yellow reeled silk from China and Italy. (2.) Spun silk. (3.) Schappe.
2. Wild silk.....Tussur.

For the production of the reeled China and Italian silks, a few dried cocoons are placed in the basin of the reeling machine, which contains hot water; several ends are then taken up and reeled or twisted into a single thread. Two or more of these are again twisted or thrown by the silk throwster, and constitute the raw silk of commerce.

Spun silk is made of the waste silk of the reeling processes, and consists of silk which cannot be reeled in a continuous thread, viz.:

(1.) The external floss silk, with outer and inner portions of the thread.

(2.) Soiled, double and defective cocoons. The silk from these sources is boiled off—all the gum being removed—then combed or carded and spun similarly to worsted or cotton yarns.

It is not generally known, I believe, that much of the spun silk produced is tinted, before being spun, with blue or other coloring matter. I have often had cause to suspect that some of the spun silks worked up in lace fabrics have been weighted also; and I am informed that the weighting of waste or spun silk is carried on to a large extent. It is, therefore, not surprising that at times silks which look clean and lustrous in the fabric before bleaching and dyeing turn out poor in color and dull in appearance after these processes are carried out. The dyer is blamed for this result, whereas the mischief is really caused by the silk spinner or manufacturer. Such practices are to be regretted; and although it is possible to weight silk up to 60 per cent. without materially impairing its color, luster or strength, such weighting, if required, should be left to the silk bleacher. Much of the material used for this purpose is liable in conjunction with the oxidation bleaching processes to tender the fiber, causing loss and damage. Raw silk is also sometimes found to be weighted in a similar manner.

Schappe silk is made in the same way as "spun," but is not boiled off before spinning, being merely softened. In the stripping process it generally gives off a disagreeable odor of decomposed chrysalides.

Tussur silk is the most important of the wild silks. The cocoons are larger than those of the Bombyx Mori, and are of a grayish fawn color. They are very hard, the fibers being stuck together by a peculiar secretion of the caterpillar which gives to the silk its drab color. Much of this silk is combed or carded and spun, the reeling being difficult, although reeled Tussur is much more largely produced than formerly. The fiber is thicker and stronger than cultivated silk, and under the microscope shows striations which appear to be small fibrets, cemented together into one whole fiber.

Broadly speaking, silk consists of an inner cylinder of fibroin and an outer coating of sericin or silk gum, the latter being about 20 per cent. to 26 per cent. of the whole. Reeled Tussur has about 23 per cent. sericin, which may be boiled off. According to Bastow and Appleyard, on treatment afterward with alcohol, a brown wax-light substance may be obtained, easily soluble in NaHO, slowly in Na_2CO_3 and rapidly soluble in soap. Another constituent of Tussur silk which is important to the bleacher is lime. Lime and magnesia salts are present to the extent of about 1 per cent. of the fiber. On calcining a few grammes of the fiber in a platinum crucible at low red heat 5·34 per cent. of inorganic substances were obtained as follows:

	Per cent.
Soda (Na_2O)	12·45
Potash (K_2O)	31·68
Alumina (Al_2O_3)	1·46
Lime (CaO)	13·32
Magnesia (MgO)	2·56
Acid radicals, etc.	39·0

The means adopted for removing this lime will be mentioned further on.

In nearly all cases when silk is to be bleached it is put through the preliminary process of stripping and boiling off.

STRIPPING.—The operation of stripping consists in working the silk in a bath of soap solution for about half an hour, with the object of first soaking and softening the silk glue and afterward partially removing it, together with the loose dirt, grease, etc., which has become attached to the silk during the manufacturing processes. For this purpose a solution of 13 lb. soap in 100 gallons of water is used at about 190° F. This liquor, containing the silk gum, can afterward be used in dyeing colors, and is known as "boiled-off liquor." In considering the precautions to be observed in carrying out this operation, it is necessary first to insist on the importance of good clear water, free from lime and magnesium salts. Hard water, if not passed through a water-softening apparatus, should be softened before use by adding to the water a suitable quantity of pure powdered 98 per cent. caustic soda. Some text books recommend the addition of Na_2CO_3 for this purpose, but since many hard waters contain more temporary than permanent hardness, this addition in most cases would be unsatisfactory, the sulphates of lime and magnesia only being precipitated, while the bicarbonates would be left in solution. The pure powdered NaHO dissolves at once and removes both permanent and temporary hardness thus:

$$CaH_2(CO_3)_2 + 2\,NaHO = Na_2CO_3 + CaCO_3 + 2\,H_2O$$
$$CaSO_4 + Na_2CO_3 = Na_2SO_4 + CaCO_3.$$

As an example it may be mentioned that a sample of town water gave on analysis a total hardness of 9·8 parts per 100,000, comprising 6·2 parts temporary and 3·6 parts permanent hardness. It will thus be seen that with Na_2CO_3 added to this water only ⅓ of the lime would be affected. For a water of moderate hardness, such as is found in this district, 2 to 3 oz. of the caustic soda may be added to a barque containing 250 gallons of water, and stirred up thoroughly for three or four minutes before use. Should this precipitation of lime salts be neglected, a quantity of sticky lime soap is fixed upon the silk during the stripping and boiling operations which in turn serves to fix any suspended matter which may get into the bath. At the same time the luster is impaired and the silky feel of the fabric to a certain extent spoiled.

The quality of the soap to be used for stripping and boiling off requires careful attention. In a recent book I find cocoa nut oil soap spoken of as a good one for this purpose. The only point in its favor, however, is that it is not decomposed by hard water with formation of lime soap. Its disadvantages are its alkalinity and the bad smell left by it on the silk. An excess of caustic alkali is inevitable in a thoroughly saponified cocoa nut oil soap, making it unsuitable for toilet purposes, since it attacks the skin; and hence for a similar reason, viz., that it attacks the animal fiber, unsuitable for ungumming silk.

The soap used must be free from caustic alkali, must rinse out well, be a good color and leave an agreeable odor. Potash soaps made from olive oil, tallow, or olein are the best for this operation. Of these, tallow soap rinses out more difficultly than either olive oil or olein soap, the latter being best in this respect. Therefore, having regard to the comparatively high price of olive oil, I consider the best soap for silk is a potash soap made from a good white tallow olein. Cotton seed olein is not so good, and is likely to leave objectionable smell on the goods. Potash soap is preferable to a soda soap, since the former is less keen—all things being equal—than the latter, and appears to preserve the luster, etc., of the silk better. The soap indicated rinses out well and leaves the silk lustrous and with an agreeable odor.

Although theoretically a perfectly neutral soap would seem to be best for stripping and boiling off, it is found in practice that a soap made slightly alkaline with K_2CO_3 gives on the whole somewhat better results; but it should be clearly understood that any alkalinity arising from caustic potash or soda is deleterious to the silk, making it dull and harsh.

BOILING OFF.—The silk after being stripped is, in the case of lace, fabrics, etc., put into boiling bags to be boiled off. The bags are loosely made of thick hempen cord, and then filled and tied at the top and put into the boiling copper, which is generally heated by fire as well as steam. In the case of hank silk, the latter is worked on sticks in the boiling bath or in specially constructed machines. The silk is then boiled in about 15 per cent. of soap, or speaking more correctly, a solution of soap containing 7 lb. of soap to 100 gallons of water, for one or two hours, according to the quality and thickness of the silk. After rinsing first in warm, then in cold water, the silk is ready for bleaching.

BLEACHING.—The several methods used in bleaching silk may be conveniently divided as follows:

1. Bleaching by treatment with acid.
2. Bleaching by reduction methods—
   (*a.*) Gas bleaching.
   (*b.*) Liquid bleaching.
3. Bleaching by oxidation—
   (*a.*) Permanganate potash method.
   (*b.*) Hydrogen peroxide.
   (*c.*) Sodium peroxide.

1. *Acid Treatment.*—The first method is frequently used in conjunction with the sulphuring process for bleaching raw yellow silk which requires soupling, the object of which is to gain the luster and feel of boiled-off silk without removing the gum, or with the loss of only a small quantity of gum. It is usually carried out as follows: The yellow silk is first softened and cleaned by working for about an hour in a warm bath of 10 per cent. soap. It is then well washed and bleached by immersing in a bath of aqua regia at about 3° or 4° Tw. The aqua regia is made by mixing 5 parts commercial hydrochloric acid with one part nitric acid and allowing to stand. The silk lies in this acid bath until it turns greenish. It is then taken out, well washed, sulphured and soupled.

Better results, however, may be obtained by using in place of aqua regia a dilute solution of sulphuric acid in which an OH group has been replaced by an NO_2 group, thus:

$$SO_2\begin{cases} NO_2 \\ HO \end{cases}$$

This is obtained by saturating the oil of vitriol with nitrous fumes, or dissolving in it a suitable quantity of chamber crystals obtained in the manufactu e of sulphuric acid. The raw yellow silk after softening by working in a 10 per cent. soap solution at 70° F. for 1 hour is well washed and entered into the acid bath at 4° Tw. and left there for 10 to 15 minutes. If it is allowed to lie in this bath too long, it contracts a yellow tint. It is then well washed and may be sulphured, afterward washing and soupling by working about 1 hour in acidulated water at 190° to 200° F. in the usual way.

This acid treatment can be used also to improve the color of boiled-off silk, by working the latter in the acid at a strength of ½° Tw. (0·0025 sp. gr.) at a temperature of about 140° to 160° F.

2. *Reduction Methods.*—In bleaching by these methods the coloring matter of the silk is destroyed by the reducing action of sulphur dioxide either in the form of gas or in solution. This reagent has been in use for several centuries, the exposure of silk and wool to sulphur fumes being a very old process. As at present carried out, the silk is hung up and spread out in a chamber generally termed the sulphur stove, heated to 90° or 100° F., which can be securely closed to confine the fumes. The requisite amount of sulphur is then lighted and left to burn itself out, the doors being securely closed. After six hours (or all night), the doors are thrown open; the gas allowed to escape; and the silk being taken out, is washed to remove sulphuric acid, etc., which may form in the goods by oxidation of the sulphur dioxide. The amount of sulphur to be burned should have some relation to the size of the chamber, and the percentages of sulphur given which have regard only to the quantity of silk to be bleached are therefore not always reliable. About ½ lb. sulphur per 1,000 cubic feet of stove room is a suitable quantity.

This process gives a distinct improvement in the color of the silk, but its effect is by no means permanent. Exposure to light and air gradually brings back the original yellow or brown tint, probably owing to reoxidation. A passage through soap or an alkaline bath also to a great extent destroys the advantage gained by sulphuring; hence it is very little use for goods which have subsequently to be dyed light colors in a soap bath. It is, however, very largely used; its cheapness being an important consideration.

Bleaching by Sodium Hydrosulphite.—Quite recently another substance which exerts a reducing action upon the coloring matter of the silk has been applied for bleaching, viz.: Hydrosulphite of soda, $NaHSO_2$. To prepare it a clean bleached tub of 50 galls. capacity may be taken. Into this are put 32 galls. of bisulphite of soda at 66° Tw. (1·33 sp. gr.) and scraps of pure zinc are added until they reach the surface of the liquid, when it is covered up for one hour. Means are taken, if necessary, to prevent the temperature rising too high; earthenware tubes being sometimes suspended in the tub through which cold water circulates. The liquid is then drawn off into another tub which is filled and covered up to prevent oxidation, and left to stand for 12 hours to allow the zinc and sodium sulphites to crystallize out. The supernatant liquor is the bleaching agent, and is also kept covered up in a full tub to avoid oxidation to bisulphite. The hydrosulphite is formed thus:

$$3NaHSO_3 + Zn = NaHSO_2 + ZnSO_3 + Na_2SO_3 + H_2O.$$

For use it is only necessary to dilute the standard bleaching agent with an equal volume of water, enter the cleansed goods, and allow them to remain in this bath for six hours; after which they are well wrung and immediately washed. If this washing is delayed, the fibers are rapidly heated and thereby injured in luster and strength. The silk should then be run through a weak hydrochloric acid bath to remove all traces of sodium and zinc sulphites, which would produce yellow stains on finished goods, and finally washed in abundant water. When the bleaching bath falls below its original level it may be replenished with fresh $NaHSO_2$, and will thus last for a considerable time. The undissolved zinc can also be made again serviceable by washing it with plenty of water acidulated with HCl.

3. *Oxidation Methods.*—Several substances which exert an oxidizing action upon the silk have been tried at various times for bleaching it. One of those most used before the introduction of the peroxides was potassium permanganate. Its action depends upon the fact that it readily gives off oxygen in the presence of organic matter. The silk was steeped in a dilute solution of the permanganate, and afterward worked in an acid bath which dissolved off the brown hydrate formed in the reaction.

The use of permanganate has, however, practically ceased, since hydrogen peroxide has been put on the market at much lower prices than formerly.

Bleaching with Hydrogen Peroxide.—This reagent has now been in use for bleaching some 18 or 20 years. Silk bleached by it was exhibited at the Paris Exhibition of 1878. It is only during the last few years, however, that its reduced price has allowed it general use. It is made from peroxide of barium by introducing the latter gradually into a calculated quantity of hydrofluoric acid until it is just neutralized. The process, which takes about 12 hours, is carried on in a copper vessel, suspended in a wooden vat filled with cold water; great care being taken to prevent a rise in temperature. The hydrofluoric acid may be regenerated from the barium fluoride formed by means of H_2SO_4. The BaO_2 is also sometimes decomposed with sulphuric or carbonic acid. Hydrogen peroxide may also be produced, as follows: Finely ground barium carbonate is moulded into bricks with sawdust and pitch, and heated in a furnace to a temperature of 1,000° C. The barium oxide thus obtained is cooled to 50° C., at which temperature it absorbs oxygen from the air. The BaO_2 is then mixed with water and decomposed by a current of carbon dioxide. The hydrogen peroxide formed is then decanted off and the precipitated $BaCO_3$ used for another operation. Hydrogen peroxide decomposes very easily, and should be kept in a cool, dark place when stored, to prevent loss of oxygen. It is more stable when slightly acid than when neutral or alkaline. According to the experiments of Kingzett, published in the journal of the Society of Chemical Industry, 1889, its stability is further

maintained by addition of alcohol, while of the acids, phosphoric acid appears to best preserve the strength.

It is sold of 10, 12 or 20 volume strength, in carboys or barrels—the former should be preferred, since in them the strength and color are better maintained. The exact meaning of the term "volume strength" appears to be sometimes misunderstood. I have come across one or two statements to the effect that 10 volume peroxide is such as with the addition of permanganate of potash produces 10 volumes of oxygen. This is plainly an error, since one-half the amount of oxygen is furnished by the permanganate, and such a solution of H_2O_2 would really only contain 5 volumes of available oxygen. A 10 volume solution is such as contains 10 times its own volume of available oxygen.

Estimation of Peroxide of Hydrogen.—Owing to the uncertain strength of many peroxides at present sold, and also to the easy deterioration of their solutions, it becomes very necessary that every lot should be carefully tested for strength. Much of the peroxide of hydrogen sold in this country as 12 volume varies in strength from 4½ volume to 9 volume. Several methods of estimation are available, viz.:

1. Titration with permanganate of potash until a faint pink color is obtained. Two grammes of the peroxide are taken, diluted with 50 c. c. distilled H_2O and titrated with a centinormal solution of permanganate of potash until the pink color appears, the peroxide being first acidulated with about 2 c. c. of H_2SO_4. The percentage and then the volume of H_2O_2 may be calculated. The reaction is as follows:

$$K_2Mn_2O_8 + 3\,H_2SO_4 + 5H_2O_2 = 2\,MnSO_4 + K_2SO_4 + 8\,H_2O + 5\,O_2.$$

Each c. c. of $\frac{N}{100}$ $K_2Mn_2O_8$ taken corresponds to 0·56 volume, or 0·17 per cent. H_2O_2, and . ·. 2 grms. H_2O_2 of 12 volume strength would require 21·5 c. c. $\frac{N}{100}$ $K_2Mn_2O_8$.

2. It may also be accurately estimated by addition of potassium ferricyanide and caustic potash thus:

$$K_4Fe_2Cy_{12} + 2\,KHO + H_2O_2 = 2\,K_4FeCy_6 + 2\,H_2O + O_2.$$

This reaction takes place with quantitative exactness. The caustic potash should be strong and used in large excess. A nitrometer (Lunge's) may be used for the estimation.

3. The strength may be estimated also by adding potassium iodide to an acid solution of peroxide, and estimating the iodine liberated with sodium thiosulphate and starch.

4. A much readier method for practical use, and one which gives approximately accurate results, may be described as follows: A 50 c. c. graduated tube closed at one end is filled with water up to about the 28 c. c. mark, and a little H_2SO_4 (say 1 c. c.) added; 1 c. c. of the peroxide to be estimated is then carefully added from a burette; the thumb placed on the mouth of tube, the latter inverted, and the volume of air read off. A few crystals of permanganate of potash are then loosely wrapped up in a bit of tissue paper and dropped into the tube; the thumb is immediately placed over the tube mouth to make it gas tight, while the hand firmly grasps the tube and shakes it thoroughly for two or three minutes. The tube is then plunged into a glass cylinder of cold water, mouth downward; the mixed gases are cooled to ordinary temperature, and the volume read off. After deducting from this the volume of air space previously ascertained, one half of the residual volume obtained represents the volume of oxygen available in the sample. While shaking, the pressure on the thumb increases, and care must be taken to keep it tightly on the tube mouth to prevent escape of gas.

A consideration of the temperature at which the bleaching is performed may enable us to speak of the two methods of bleaching with peroxide of hydrogen, viz.: (1) the cold method; and (2) the warm method.

Cold Method.—A bath is prepared by diluting a quantity of 12 volume peroxide with three times its volume of cold water, and adding sufficient ammonia to cause the bath to smell faintly of it, and cause small bubbles of oxygen to slowly rise to the surface. The goods are immersed in this liquid for one, two or three days, according to the amount of bleaching required. As a rule, it is unwise to leave goods in this liquor longer than three days, as after this time the luster and strength are likely to suffer. Borax, oxide of magnesium, silicate of soda, and other substances may replace the ammonia; and their comparative advantages are dealt with further on in speaking of Tussur bleaching.

Warm Method.—In this method a bath is made up at 1 part of 12 volume H_2O_2 to 10 parts water or 1 part to 20 of water, according to the amount of bleaching the silk requires. An addition is made to the bath of ammonia, or preferably for this method one of the above named substances; the silk is entered, worked for one-fourth hour, gradually heated up to 100° F. during one hour, and then worked for three-fourths hour at this temperature, washed and scrooped.

Sodium Peroxide.—Quite recently there has been introduced a new product for bleaching silk, viz.: Peroxide of sodium, Na_2O_2. It is manufactured by the Aluminum Company, Limited. The method of manufacture as described by Mr. Castner, the patentee, consists in treating metallic sodium contained in aluminum vessels at a temperature of 300° C., to the gradual oxidizing action of a mixture of oxygen and nitrogen in which the proportion of oxygen is gradually increased. This is done in an iron pipe which passes through the furnace and along which a current of air is passed from one end. The vessels containing the sodium pass along the entire length of the pipe, the sodium being oxidized at first by air which has been almost deprived of its oxygen, the proportion of the latter gradually increasing until it is finally oxidized by air containing the full amount of oxygen.

This method is not unlike that pursued in the manufacture of barium peroxide, in which BaO, prepared by reducing the nitrate in fireclay crucibles, is heated at a high temperature in a retort, air being allowed to pass in at one end and nitrogen to escape at the other.

The average analysis of Na_2O_2 (for which I am indebted to Mr. F. Burton, of London) shows:

	Per cent.
Peroxide sodium	93·0
Protoxide "	2·0
Carbonate "	2·5
Hydrate "	2·5

Compared with BaO_2 and H_2O_2 (10 vols.) solution, the available oxygen is as follows:

93 per cent. sodium peroxide	19·5	per cent. available O.
91 per cent. barium peroxide	8·6	" "
H_2O_2 10 vol. solution	1·6	" "

It is a yellowish white partially powdered substance which dissolves in water with a hissing sound and great evolution of heat. These characteristics are possibly partly due to particles of metallic sodium from which the peroxide is made. As at present delivered to the consumer it is by no means free from impurities, and dark colored particles are found which might be expected to be slightly prejudicial to its bleaching effect. It is strongly alkaline and very deliquescent. *In keeping it care must be taken to keep it dry and to prevent its contact with inflammable materials, such as cotton, paper, etc.* If kept dry, it is more stable than H_2O_2, and if used carefully it comes cheaper. The makers claim for it that 1 lb. is equal in bleaching power to 1⅔ gallons of 10 volume H_2O_2. They recommend its conversion into H_2O_2 by adding it gradually to dilute H_2SO_4; but if this is done in strong solutions without the use of suitable cooling arrangements, much loss of oxygen results and the ultimate product is much dearer than ordinary H_2O_2. To make 10 gallons of 10 volume H_2O_2 take 10¼ lb. H_2SO_4 168° Tw., mix with 8 or 9 gallons H_2O and cool. Then add 7½ lb. sodium peroxide gradually and with continual stirring, special cooling arrangements being used to keep temperature low, without which it would rise considerably and oxygen would be lost.

It is, however, better in practice to make the Na_2O_2 into H_2O_2 of 1 volume strength or such strength as is required for bleaching, in order that the extra water required may be utilized to cool the whole, and so prevent escape of oxygen. Thus a 1 volume H_2O_2 bath may be made by adding to 94 gallons of water 10¼ lb. H_2SO_4 168° Tw., previously diluted with 2 gallons H_2O and cooled, then gradually with stirring 7½ lb. Na_2O_2. In making up these solutions I find they are always slightly colored yellowish brown; and on throwing down this coloration and examining it, it was found to consist of oxide of iron. This impurity is the most serious defect of the sodium peroxide at present sold; and it is to be hoped the makers may be able in the future to eliminate it. It can, however, be got rid of by a suitable addition to the bath, which carries it down to the bottom of the vessel. Another method of using peroxide of sodium will be mentioned later under the head of Tussur bleaching.

Bleaching of Tussur Silk.—In consequence of the secretion which permeates the silk of the Tussur cocoon being more difficult of removal than in the case of cultivated silk, other and keener substances are sometimes used in the stripping bath, such as caustic soda, potash, etc. The following trials were made on reeled Tussur to determine the best scouring agent to use in stripping and boiling off:

No. 1, stripped ½ hour and boiled 1 hour in..	¼ oz. Na_2CO_3 to 1 pint H_2O.
No. 2. do. do.	½ oz. Na_2CO_3 + ½ oz. soap in 1 pint H_2O.
No. 3. do. do.	⅛ oz. NaHO to 1 pint H_2O.
No. 4, steeped 1 night (12 hours) in a bath containing in three pints water.....	½ oz. soap. 3 c. c. ammonia 0·880. 1 c. c. turpentine.

No. 4 looked cleanest and best, No. 3 better color than 1 and 2, but not quite so lustrous. Nos. 1 and 2 gave practically equal results. These four samples were bleached with H_2O_2 with addition of silicate of soda by the warm method.

No. 4 did not bleach well, the turpentine evidently interfering with the result. Nos. 1, 2 and 3 appeared to be very much alike in color, No. 3 not being quite so lustrous.

The older bleaching processes which are still useful for cultivated silks are comparatively useless for Tussur, and the latter can only be bleached satisfactorily by the use of peroxides of hydrogen or sodium. A number of methods have been proposed, in which other reagents are used previous to the peroxide bath, but the best of these produce no better result than when peroxide is used alone, as will be shown by the bleaching trials given further on, while the luster and feel are more or less impaired by them. Professor Lunge is said to have written favorably of a combination of the sulphuring and peroxide methods (see Hurst, silk dyeing, p. 32). But if the theory given of the action of these processes is correct, viz., that they act by reduction and oxidation respectively, the one process might be expected to neutralize the effect of the other. This appears to be so in practice. So far as Tussur silk is concerned a sample was sulphured for 12 hours, washed and bleached in a peroxide bath of 2 volume strength for three days. The result was distinctly inferior to a second sample bleached in the same strength of peroxide alone. Boiled-off Tussur, was used for this experiment.

Another method given for bleaching Tussur silk in Mr. Hurst's recently published book on silk dyeing, and attributed by him to H. Koechlin, is to boil or steep the silk in a bath of 22 lb. caustic soda, 66 lb. soap, 11 lb. calcined magnesia, 11 gallons 10 volume peroxide of hydrogen, and a little ammonia. This bath would not simply bleach the Tussur, but would dissolve it. It was really recommended by Koechlin for bleaching *cotton* with hydrogen peroxide and does *not* give "excellent results" with Tussur as stated by Mr. Hurst.

The following method was proposed by Ch. Girard, and has been applied for bleaching Tussur spun silk on the Continent:

1. Work in warm dilute HCl (1 to 8) for 1 hour.
2. Wash and strip with sodium carbonate or 2 per cent. caustic soda, and wash.
3. Steep in hypochlorite of ammonia for 24 hours. This bath may be repeated.
4. Wash, pass through dilute HCl and wash.
5. Steep in hydrogen peroxide of one-half volume strength with addition of ammonia or borax.

The first hydrochloric acid bath is beneficial, in that it removes the lime present in Tussur silk, but the treatment with ammonium hypochlorite before bleaching with hydrogen peroxide is quite a superfluous process, and no advantage can be gained by its use, as the following bleaching trials show:

No. 1 sample was stripped half an hour and boiled one hour in ¼ oz. Na_2CO_3 to 1 pint water.

No. 2 was steeped in warm dilute HCl (1 in 6) for one hour, washed, then stripped and boiled as No. 1, and steeped in hypochlorite of ammonia at 1° Tw. for 24 hours.

No. 3 was treated as No. 2, but steeped in hypochlorite of soda at 1° Tw. for 24 hours.

All three were washed and separately steeped in H_2O_2 (1 vol.) with 2 c. c. AmHO added to 22 oz. for three days, then washed and scrooped.

No. 1 gave the best result both in color and luster. No. 3 became tender in the Na_2Cl_2O solution—1° Tw. being evidently too strong—but as No. 1 gave best color the trial was not repeated.

The ammonium hypochlorite was made by adding 1⅔ oz. Am_2CO_3 dissolved in ½ pint water to 1 oz. bleaching powder rubbed down in ½ pint water, allowing to settle and using the supernatant liquor.

The sodium hypochlorite was made by mixing 5¾ oz. bleaching powder in 1 pint water, and 3¼ oz. crystal carbonate in 1¾ pints water; the latter is added to the former mixture gradually; the mixture becoming much thicker, and then suddenly thin again near the completion of the reaction. It was then allowed to settle, and the liquor poured off for use.

Experiments were then made to determine the best and most economical strength of peroxide of hydrogen to use in bleaching. Three samples of reeled Tussur were worked in hot dil. HCl for 20 minutes, washed, stripped, and boiled in Na_2CO_3 solution ¼ oz. to the pint, then steeped in peroxide of hydrogen solution as follows:

Strength of 12 vol. H_2O_2.	AmHO added.	Result after 24 hours.
No. 1.—1 part H_2O_2 to 3 parts water.	2 c. c. AmHO. to 22 oz. liquor.	Nos. 1 and 2 were distinctly better than No. 3.
No. 2.—1 part H_2O_2 to 10 parts water.		
No. 3.—1 part H_2O_2 to 20 parts water.		

Left them in bleach three days.

On the second day there was a slight improvement in all. The third day scarcely helped them. On the third day they were heated in their respective liquors to 190° F. for two hours. This treatment improved the color considerably without impairing the luster perceptibly. After heating No. 1 was slightly better than 2. Nos. 1 and 2 much superior to No. 3.

A third series of experiments was made to determine the best addition to make to the peroxide of hydrogen bath, with a view to producing the best color consistent with strength and luster. Four samples of reeled Tussur prepared as indicated in previous series were bleached in 12 vol. H_2O_2 diluted with 10 times its weight of water, with various additions as follows:

Additions made to 22 oz. peroxide liquor.	Result after 1 day.	Result after 2 days' cold bleaching, then heating to 190° F. in respective liquors.
No. 1. 2 c. c. AmHO @ 0·880.	Better than 2.	About alike.
No. 2. ¼ oz. $Na_2B_4O_7$....	Inferior to 4. Darker than others.	
No. 3. ¼ oz. MgO.....	Same as No. 1.....	Slightly better than 1 and 2.
No. 4. ¼ oz. Na_2SiO_3 @ 140° Tw.	Clearest. Rather yellower than others.	Much the best.

No. 4 gave a very good result. It was a clear good color, and lustrous, and its strength was not perceptibly diminished.

Sodium Peroxide.—Very good results may be obtained by bleaching Tussur with sodium peroxide by the following method recently patented by Dr. Haen. For 50 lb. of Tussur a bath is prepared containing 30 lb. Epsom salts in 110 galls. water. The silk after being boiled off and well washed is thoroughly impregnated with this liquor and lifted; and then 6 lb. 10 oz. peroxide of sodium are carefully added in three portions during three-quarters of an hour, working the silk in the bath after each addition. It is important not to neglect the first impregnation with $MgSO_4$ solution, as the luster would be impaired by the strongly alkaline peroxide of sodium acting upon the silk. The whole is then gradually heated during three-quarters of an hour to 190° F., the operation lasting about two hours. Dilute sulphuric acid is then added to clear the liquor, which has become milky through separation of magnesium hydrate. The material is given two or three turns in this liquor, washed, and then worked for half an hour in a bath of 30 per cent. soap to increase and restore its luster, washed and brightened by stringing, etc.

The reaction which takes place appears to be the following:

$$MgSO_4 + Na_2O_2 = Na_2SO_4 + MgO + O.$$

Samples bleached by this method gave a color scarcely inferior to that obtained by means of hydrogen peroxide and sodium silicate; the luster, however, was not quite so good before soaping. $ZnSO_4$ was tried in place of $MgSO_4$, but did not give so good a result, although it gave a fair color. It may be noted, that by working silk after bleaching for half an hour in a 30 per cent. soap bath, afterward washing and scrooping, the luster of the silk is improved, that being the case especially with Tussur. In concluding I desire to ac-

knowledge the assistance of Mr. Furley Davis in carrying out the bleaching trials.

In the discussion which followed, the chairman among other things said: As to peroxide of sodium, he was glad Mr. Pentecost had referred to the dangerous nature of the chemical, which would easily set fire to cotton, wool, hay, straw, and even wood upon which it had become spilled if water were dropped upon it.—*Jour. Soc. Chem. Ind.*

IMPROVEMENTS IN GALVANIZING IRON.

G. RETTERER, Paris, France.

IN the ordinary manufacture of galvanized iron by dipping there is a considerable production of hard spelter and excessive volatilization, owing to the necessity of uncovering the metal while the sheet is being withdrawn. This invention consists in mechanical means for overcoming these difficulties. The apparatus (Fig. 1) consists of a bath, *c*, divided above into two compartments by the partition, *h*. The bath, *c*, and compartment, o^1, are filled with lead; the compartment, *o*, contains spelter, which floats on the lead. In the compartment, *o*, at the surface of the spelter are two movable bars, *k*, k^1 (Fig. 2), supported by rods, *m*, m^1, pivoted at *n*, n^1. In order to coat a plate it is thrust into the compartment, *o*, and submerged until its upper edge is below the partition, *h*. It is then released and floats upward, pushing apart the bars, *k*, k^1, which in their turn push aside the powdered coke with which the metal is covered. A small clear space is thus produced sufficient for the removal of the sheet. The surface of the lead in the compartment, *o*, is covered with sal-ammoniac.

Fig. 1.

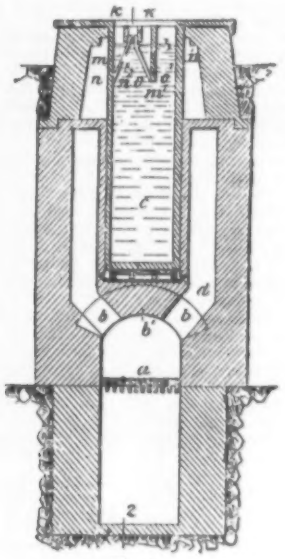
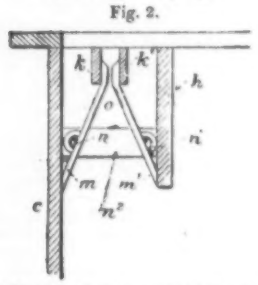


Fig. 2.

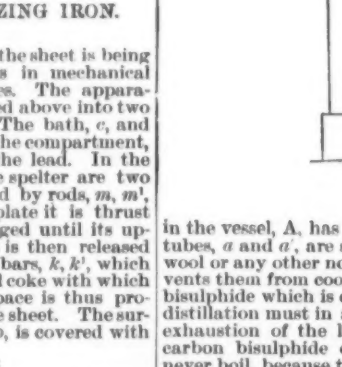


APPARATUS FOR GALVANIZING IRON.

IMPROVEMENTS IN MELTING FURNACES.

F. H. MALLAHAND, Kirkcaldy, London.

THIS is a furnace for general melting purposes, and can be used either with coke or gaseous fuel. If the former is used the metal is placed in a crucible, O, which is then packed round with coke. An air blast passes from the box, *c*, through tubes, c^1, of which there are several, into the furnace, A. It also passes through P and P^1 into a lower compartment, F, which receives the metal as it melts. The tube, P, can be deflected as shown by the dotted lines, to allow of the removal of samples from F and for rabbling. The products of combustion from the furnace, A, pass through S into B, and finally escape to the chimney through U. The furnace, B, contains scrap, or metal receiving a preliminary heating before being transferred to A. Any metal which may be melted in B passes through R into F. The openings, D, D^1, in the two furnaces communicate with a channel, E, and are for the escape of slag. The channel, E, is kept hot by the gases passing from A to B. The metal is drawn off through the spout, Q. If gaseous fuel is to be used the crucible is removed, the arch, G, completed, and the body of the furnace filled with the metal to be melted. The blast in C is cut off, the flue, U, closed, and two ports, J, J^1, are opened. Each of these communicates with a pair of regenerators, conveying air and gas respectively, and the flame is passed from A to B and from B to A as the pairs of regenerators respectively become heated and cooled down.



IMPROVED MELTING FURNACE.

EXTRACTION OF GUTTA PERCHA.

THE invention of Dieudonne Rigole, of Singapore, Straits Settlements, relates to a process and apparatus for extracting gutta percha from the leaves and twigs of *isonandras*, *dichopsis* or other gutta percha trees by the use of carbon bisulphide, thus avoiding the common practice of cutting down these valuable trees, which require twenty-five years to reach maturity.

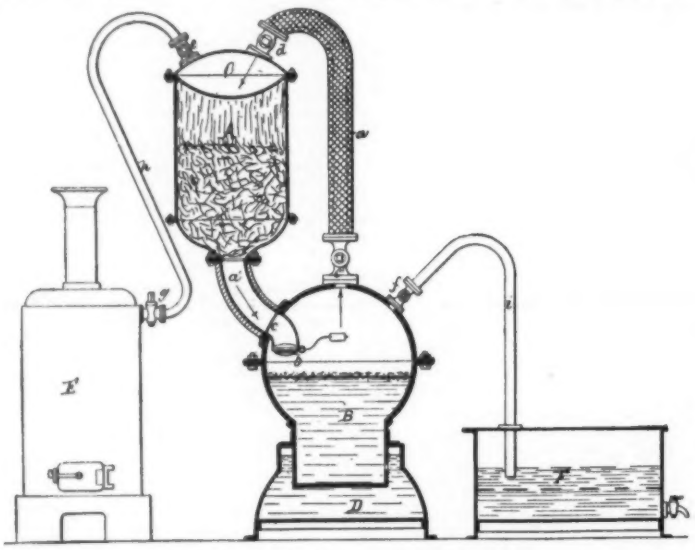
The leaves and twigs from which the gutta percha is to be extracted are suitably pounded so as to uncover the cells containing the gum. In this state they are introduced into an exhausting vessel, A.

The carbon bisulphide is put in the boiler, B, passes through the tube, *a*, in a state of vapor into the condenser, C, where it condenses and then traverses the pounded leaves and twigs. The condensed vapors from the bisulphide containing the soluble principles then return to the boiler, B, through the tube, *a'*, the lower part of which is provided with an automatically operating flap, *b*, for permitting the passage of the gum into the boiler, B. Across the bore of the tube, *a'*, is placed a very thin wire gauze, *c*, serving as a filter or rather as a strainer. After the bisulphide has collected a certain portion of the gum, which it conducts to the boiler, B, where the same is deposited, it escapes through the tube, *a*, in order to condense again in the space, C, and recommence its exhausting operation until the gum contained in the leaves and twigs in the vessel, A, has been completely extracted. The tubes, *a* and *a'*, are surrounded by a sleeve of cotton, wool or any other non-conducting material which prevents them from cooling. In this manner the carbon bisulphide which is continually being purified by the distillation must in a short time effect the complete exhaustion of the leaves and twigs. Of course the carbon bisulphide contained in the boiler, B, must never boil, because the gum collected would otherwise become quite oxidated, which inconvenience is obviated by placing the said boiler in a water bath, D, wherein water is kept at the maximum temperature of 45° Centigrade. A steam boiler, E, is connected to the vessel, A, by a tube, *h*, provided with cocks, *e* and *g*. A tube, *i*, provided with a cock, *f*, leads from the boiler, B, to a vessel, F. When the exhaustion of the leaves and twigs is complete the valve, *c'*, leading from the boiler, B, to the tube, *a*, is closed to prevent the communication of the boiler, B, with the tube, *a*. I also close the cock, *d*, which connects the tube, *a*, with the vessel, A, and open the cocks *e*, *f* and *g*, and introduce into the vessel, A, a powerful jet of superheated steam. This steam comes from the boiler, E, through the tube, *h*, and passes into the boiler, B, through the tube, *a'*. It will carry away the few globules of gum which may still be in the leaves and twigs, traverse the tube, *a'*, in order to pass to the boiler, B, containing the gutta percha in solution in the carbon bisulphide, and introduce the vapors through the cock, *f*, into the discharge tube, *i*, the extremity of which dips a short distance into the water contained in the vessel, F. The carbon bisulphide having a greater specific weight than water, falls naturally to the bottom of the vessel, F. When the gum has all been extracted from the leaves and twigs, the gutta percha is in a liquid state mixed with the solvent. As the steam carries away the carbon bisulphide and precipitates it in the bath, F, the gutta percha in the boiler, B, thickens, and when the last traces of the solvent are removed the gutta percha has become a solid body but capable of being kneaded if put into warm water. In order that no bisulphide shall remain in the gum the introduction of superheated steam may be prolonged in such a manner that the gutta percha will not be affected by its action and that its oxidation need not be feared.

The complete operation ought not to occupy more than twenty-two to twenty-five minutes for obtaining chemically pure gutta percha.

Other solvents than carbon bisulphide would give similar results, such as benzine, chloroform and the like, but the price of these substances, which I have tried, augments the cost of the gutta percha so much that their employment is not practicable for commercial purposes.

If use is made of benzine as a solvent, the gum collected will contain some traces of this substance, the elimination of which presents almost insuperable difficulties.



EXTRACTION OF GUTTA PERCHA.

CUT NAILS AND WIRE NAILS.

THE following is a summary made by consulting engineer William H. Burr from the detailed official report of commanding officer J. W. Reilly, Major, Ordnance Department U. S. A., in command of the United States Arsenal at Watertown, Mass., and of the United States testing machine at that station, showing the results of the recent official tests made for ascertaining the relative holding powers of cut nails and wire nails, of equal lengths and weights; which tests were made at the United States Arsenal at Watertown, Mass., under the supervision of Major Reilly, in accordance with an invitation of the Eastern cut nail manufacturers of the United States to the wire nail manufacturers of the United States, dated November 4, 1892. The tests were made in November and December, 1892, and January, 1893:

The series of tests, each series comprising ten pairs of cut nails and wire nails of one size, were, in number	58
The number of nails tested was	1160
The nails ranged in length from	1¼ to 6 in.
The number of series in which the cut nails showed the superior holding power was	58
The number of series in which the wire nails showed the superior holding power was	not any
All the nails tested were driven in	spruce wood
Additional tests were made, of the box nails only, in	pine wood
In spruce wood, in 9 series of tests, comprising 9 sizes of common nails (longest 6 in., shortest 1⅝ in.) the cut nails showed an average superiority of	47·51 per cent.
In spruce wood, in 6 series of tests, comprising 6 sizes of light common nails (longest 6 in., shortest 1⅝ in.) the cut nails showed an average superiority of	47·40 per cent.
In spruce wood, in 15 series of tests, comprising 15 sizes of finishing nails (longest 4 in., shortest 1⅛ in.) the cut nails showed an average superiority of	72·22 per cent.
In spruce wood, in 6 series of tests, comprising 6 sizes of box nails (longest 4 in., shortest 1¼ in.) the cut nails showed an average superiority of	50·88 per cent.
In spruce wood, in 4 series of tests, comprising 4 sizes of floor nails (longest 4 in., shortest 2 in.) the cut nails showed an average superiority of	80·03 per cent.
In spruce wood, in above 40 series of tests, comprising 40 sizes of nails (longest 6 in., shortest 1⅛ in.) the cut nail showed an average superiority of	60·50 per cent.
In pine wood, in 6 series of tests, comprising 6 sizes of box nails (longest 4 in., shortest 1¼ in.) driven with taper perpendicular to grain of wood, the cut nail showed an average superiority of	135·20 per cent.
In pine wood, in 6 series of tests, comprising 6 sizes of box nails (longest 4 in., shortest 1¼ in.) driven with taper parallel to grain of wood, the cut nail showed average superiority of	100·23 per cent.
In pine wood, in 6 series of tests, comprising 6 sizes of box nails (longest 4 in., shortest 1¼ in.) driven in end of wood, the cut nail showed average superiority of	64·38 per cent.
In pine wood, in above named 18 series of tests, comprising 6 sizes of box nails (longest 4 in., shortest 1¼ in.) driven in three ways, the cut nail showed an average superiority of	99·93 per cent.
In spruce and pine wood combined, in the whole 58 series of tests, comprising 40 sizes of nails (longest 6 in., shortest 1⅛ in.) the cut nails showed average superiority of	72·74 per cent.

MAGNESIA FIREBRICKS.

SOME weeks ago, at a meeting of the French Society of Civil Engineers, a discussion took place on the possibility of obtaining higher temperatures in steel furnaces. At present the temperature is limited by that at which the walls of the furnace begin to fuse, and even Diners firebricks are not proof against this. Magnesia is claimed to be capable of standing far higher temperatures than the Diners brick. It is used according to a statement made at the meeting referred to, by M. Lencauchez, and was first proposed by M. E. Muller in 1869. The principal difficulty in using it is the excessive shrinkage to which it is liable when heated. Thus, a cube of magnesia of 10-in. edge in the raw state is said to shrink to one of 6-in. edge when sufficiently calcined. For this reason furnace linings made of this material were liable to crack badly. The remedy for this state of things is to cause the magnesia to undergo its maximum possible contraction before being placed in the furnace, but for this an excessively high temperature is required.

These difficulties have, it is claimed, now been overcome, and M. Lencauchez showed the Paris Society of Civil Engineers a number of perfectly solid bricks of magnesia, which were as dense as granite, and had

been thoroughly shrunk. On analysis the bricks are found to have the following composition:

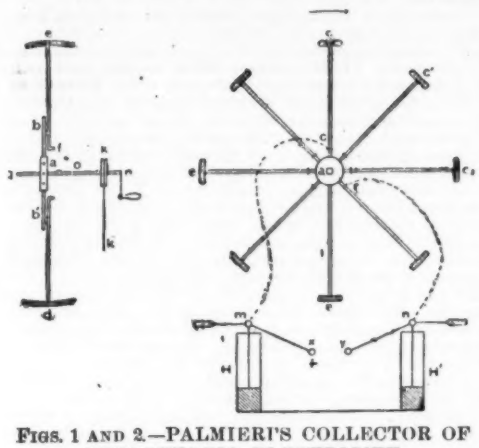
Silica	1·50	to	2·50
Alumina and iron oxide	0·75	"	1·25
Lime	1·50	"	3·00
Magnesia	96·25	"	93·25
	100·00		100·00

The high temperature required to insure that the bricks shall not be liable to further contraction is obtained by suitably designed gas kilns.

A COLLECTOR OF ATMOSPHERIC ELECTRICITY.*

By L. PALMIERI.

THE apparatus is based on the principle that as a conductor is raised in the open air it collects positive electricity (in ordinary weather), and that then, after



FIGS. 1 AND 2.—PALMIERI'S COLLECTOR OF ATMOSPHERIC ELECTRICITY.

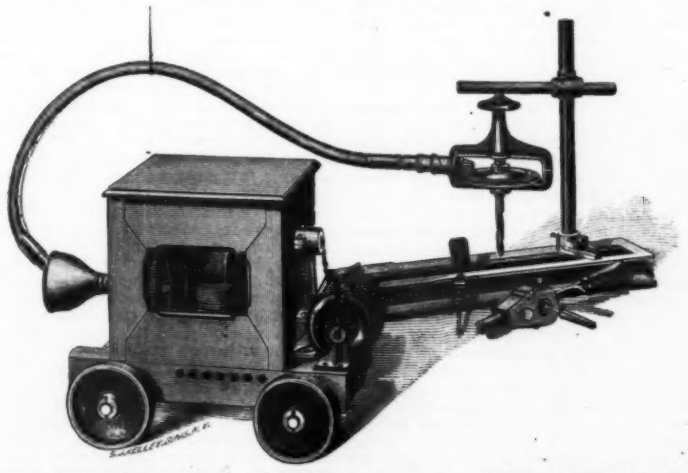
discharge, it collects negative electricity as it descends. Since 1850, the date at which I undertook the study of these phenomena conjointly with those of the ascending and descending liquid vein and others, again, which I called phenomena of approach and recession, I conceived the idea of constructing a rotary electrical machine, which became a source of electricity on fine, calm days. I made an entirely rough piece of apparatus, which is shown in several editions of my "Leçons de Physique," but it was always my intention to give it a convenient form and to add a suitable condenser. It is this rough piece of apparatus which is shown diagramatically in the accompanying illustrations.

Let *a* (Figs. 1 and 2) be a modern disk, upon the circumference of which are fixed eight insulated rods, *b b'* (Fig. 1). These rods carry an equal number of conductors, *l l'*, terminated at the top by narrow strips, *c c'*, of any convenient length; at the bottom the rods are terminated by little elbows *f*. Both wheel and spokes can be made to revolve rapidly round the axle, *q n o* (Fig. 1), either by means of a handle or an endless cord, *k*. A spring or strip of metal touches the projection, *f*, of each spoke as it reaches a vertical position, and a second one presses against the spokes as they come to the diametrically opposite position, so that positive electricity is collected at *c* and negative at *r*. At H and H' are placed two Leyden jars, similar to those used in the Toepler and Holtz influence machines, *x* being the + terminal and *y* the — terminal of the machine.

Such is the collector in all its simplicity. In this note I only wished to describe its principle, and will say something at another time about the effects it enables one to obtain.

COMBINATION OF STOW FLEXIBLE SHAFT AND ELECTRIC MOTOR.

FOR nearly twenty years the Stow flexible shaft has been on the market in connection with various other



COMBINATION OF STOW FLEXIBLE SHAFT AND ELECTRIC MOTOR.

tools designed and manufactured by the Stow Mfg. Co., of Binghamton, N. Y., for drilling, tapping and reaming.

Thousands of these are in use in the various railroad, machine, boiler and bridge shops in both this country and Europe. The Stow flexible shaft passed its experimental stage years ago, and we think is now regarded by the general trade as a standard tool.

There has been for the past few years among the larger shops a growing tendency to increase the range of this tool beyond that for which it was originally designed. This demand has been met from time to time by increasing the length of the driving rope and adding extra idlers for the support of same; but the objection has been urged that when traveling cranes or other overhead machinery were used, the driving rope was in the way.

It is stated that all these objections are overcome by the use of the flexible shaft in connection with a specially designed low speed electric motor.

The manufacturers have had this combination under consideration for the past two years, and as a result of long continued and expensive experiments, are now able to offer to consumers where electric power can be had, an electric portable drilling, tapping and reaming plant that can, without trouble or loss of time, be carried to any distance from the source of power and, with proper usage, will undoubtedly give satisfaction.

The motor has a normal speed of about 600, which can be increased by rheostat to 1,000 and 1,200, and reduced by gears to 275 without loss of power. These motors are manufactured for a voltage of either 110, 220 or 500.

RHUS POISONING.

By H. W. FELTER, M.D.,

Cincinnati, O.

WITH the approach of the spring and summer months will come the usual number of cases of rhus poisoning or *dermititis venenata*. These cases will occur principally in the rural districts, though occasionally the city physician will be called upon to treat cases in young persons, especially high school pupils, who make frequent excursions into the country for the purpose of securing specimen plants for botanical study.

This kind of specific skin affection is caused by the volatile principle of several species of the genus *Rhus*—principally, in this section, the *Rhus toxicodendron*, the *Rhus radicans* (a variety of the same species as the former, differing only in habit), and the *Rhus venenata*. The former is well known as the poison ivy, poison oak or poison vine; the latter as poison sumach, swamp sumach, and erroneously as poison dogwood and poison elder. *Rhus pumila* and *Rhus divursibia*, growing in some sections of the country, are also actively poisonous. This poisonous principle is the volatile *toxicodendric acid*, and is not a poisonous alkaloid, as was once thought to be the case. This acid is a constituent part of the acrid, milky juice, which exudes when the plant is bruised or cut—a juice which, when exposed to the light, will turn black, leaving an indelible stain. Consequently it has been employed by a few for marking linen. The stain, however, may be effaced by the application of sulphuric ether, which will dissolve it.

Horses, cattle, sheep, and, in fact, all herbivorous animals may feed among or upon the poisonous species of *Rhus* with impunity. Man and dogs are peculiarly susceptible to its toxic action. While not fatal to man, dogs have been killed by the poisonous vapor of the plant alone—death being accompanied by a general swelling of the body. Externally upon man it acts as an irritant, producing a vesicular, eczematous or erysipeloid inflammation. All individuals are not alike affected by it. With some contact with the acrid, milky juice is necessary to produce its toxic effects; others are poisoned merely by the exhalations given off by the plant, even though they be a considerable distance from it. This is especially likely to occur on a damp, warm, murky morning. Others, again, like the writer, can handle the plant freely, even besmearing the hands with the juice, without experiencing the slightest poisonous effects.

Though the toxic principle is volatile, it may be held in alcoholic solution for an indefinite length of time. Dr. Lawrence Johnson, in his Medical Botany, testifies to having been poisoned while experimenting with a tincture of *Rhus toxicodendron* which had been prepared thirty years before. The intensity of the toxic activity varies in those who are poisoned by it, some being but slightly affected, while others may be completely disabled by it. A young woman in the employ of Prof. J. U. Lloyd is intensely poisoned, sufficiently so to be confined to bed, by the emanations from rhus when the specific preparation is being transferred from the container to the shipping bottles. When it is known that rhus is to be handled in the laboratory, she is warned to absent herself until the work is completed. It is asserted that persons have been poisoned from simply handling Japanese boxes that have been lacquered with a varnish prepared from the *Rhus vernix*, a poisonous species of Japan.

Poisoning from rhus, so far as the skin affection is concerned, differs little whether the person is poisoned from the emanations or from direct contact with the plant—the effect being an acute dermatitis. From a few hours to several days after the exposure the part becomes erythematous, soon becoming œdematous, though in some cases the œdema is absent. The parts become in some individuals enormously swollen, especially the genitals and face. I have seen cases in which the face was so swollen that the eyelids could not be opened, and the patient had lost, so far as features were concerned, all resemblance to the human species. A blister, surrounded by several smaller vesicles, now makes its appearance. The itching and burning are often so intolerable as to cause the patient to scratch the parts, thus breaking the blister and making an ugly raw sore. The contents of the blister coming in contact with the healthy parts creates a newly poisoned area.

This inflammation somewhat resembles erysipelas, having much the same appearance and spreading in much the same manner. The favorite seat of the trouble is on the face and genitalia, forearm and leg. It is probably carried to the genital organs by the hands. Constitutional disturbance is often marked, nausea, vomiting and abdominal pain supervening. Lumbar pains and pains in the joints may accompany the local lesion; fever and profuse diaphoresis also being present. The bowels and kidneys may partake of the trouble, resulting in diarrhea or diuresis, with hemorrhage. The trouble is at its height in five or six days, though some cases, especially in those disposed to eczematous affections, the disease may last for several weeks, and may recur from time to time after the local manifestations are apparently cured. With the subsidence of the active inflammation free and complete desquamation takes place.

Perhaps no common ailment has brought out so many remedies as rhus poisoning. Nearly every doctor has a favorite specific (?) for its cure. In this affection cleanliness is clearly of great importance, as in any other skin disease. For this purpose the parts should be thoroughly washed with asepsin soap and warm water, the latter being applied freely to the affected area. Following this any of the following lotions may be employed for its local effect:

1. *Lobelia.* An infusion of lobelia inflata has been a favorite local application with many eclectic physicians, and is nearly as specific as any remedy in the materia medica. It has enjoyed quite an extensive use in domestic medicine for cases of poisoning of this nature.

2. *Salix Nigra.* I have seen excellent results from a decoction of black willow or pussy willow freely applied with wetted cloths.

3. *Impatiens pallida and fulva*, bruised and applied, or simply the expressed juice applied, has promptly relieved cases that have come under my observation.

4. *Grindelia Robusta* (fluid extract ʒ ij., water ℥ iv.), locally applied, is highly lauded by old-school doctors.

5. *Alum Curd* (alum ʒ ss. beaten up with the white of one egg) will often relieve the itching and burning, and will prove soothing and effectual when the face is the seat of the affection, and particularly when an application is to be used on and around the swollen eyelids.

6. *Specific Veratrum*, locally painted, has been recommended, though I have no personal knowledge of its action.

7. *Hamamelis* (distilled) is an excellent and clean application. An elegant and effectual lotion may be made by shaking up with distilled hamamelis (℥ j.) about twenty grains of asepsin. This makes a pleasant remedy, having the combined odors of witch hazel and wintergreen, and is of a slightly greenish-yellow color. With me it is a favorite application for burns.

8. *Liquor Sodii Boratis Compositus* (Dobell's solution—borax and sodium bicarbonate *aa.* ʒ ij., acid carbolic grs. xxiv., aqua Oj.) has proved a useful application. It serves the purpose of alkaline washes, which are so frequently employed in treating rhus poisoning.

9. *Lead Acetate* (solution) has failed as often as it has relieved. The same is true of zinc sulphate.

10. *Iron Sulphate* (℥ j. to water Oj.), according to Prof. J. U. Lloyd, applied freely to the parts, makes an excellent and effective lotion.

11. *Asepsin Soap* cured a stubborn case of chronic rhus poisoning. A thick lather was applied to the affected parts and allowed to dry on without rinsing or wiping. (See paper by Prof. F. J. Locke in *Journal* for March, 1893.)

A singular thing in the treatment of rhus poisoning is the fact that specific *Rhus toxicodendron*, internally administered in small doses, will hasten the cure of the local manifestations in cases where the topical remedies fail to be of benefit.—*Eclectic Med. Jour.*

PHYSICAL GEOGRAPHY OF THE OCEAN BOTTOM.

By RALPH S. TARR.

A STUDY of the rocks shows that by far the greater number have been formed beneath the waters of the ocean. The fate of the dry land is to be worn away, bit by bit, the object of the sea to assort these particles and arrange them in layers. Life, which exists in the ocean, at death falls to the bottom and in many cases the hard parts are preserved as fossils. Later these strata may be elevated above sea level, for both continents and ocean bottoms are changing in elevation.

It is true that the greater part of the stratified rocks which at present make up the main part of the continents have been formed in that part of the ocean near the shore line. Here rivers are pouring their sediment-laden waters into the sea, here waves and tidal currents are busy wearing away the shore and transporting sediment to a place of rest. A few miles from the shore the water is clear and but very little constructive work is being done, while practically no work of destruction is accomplished.

My purpose is not to consider this relatively more

* *La Lumiere Electrique.—Electrical Engineer.*

important area, but rather the less well known and really more unimportant region of the ocean bottom far from shore. It has been but a very few years since it was the current belief that the vast area of the ocean bottom was a desert waste, a great submarine plateau void of life. The British naturalist Forbes states the prevalent opinion of his time in these words: "As we descend deeper and deeper in this region its inhabitants become more and more modified and fewer and fewer, indicating an approach toward an abyss where life is either extinguished or exhibits but a few sparks to mark its lingering presence."

Reports of occasional specimens found clinging to sounding lines occasionally found their way to the ears of naturalists, but met with little favor, for it was believed that the conditions were such that animals could not possibly exist. It was not until the Atlantic cable was laid that the existence of life on the ocean bottom became demonstrated, and since then much light has been thrown upon these deep recesses by the explorations conducted by several nations.

Few parts of the deep sea are better known than that portion between southern New England and the Bermudas, and a description of the conditions here will apply in general to all the ocean bottom. Beginning at the coast line, there is a great submarine plateau sloping gently seaward for a distance of from eighty to one hundred miles, where it is not far from six hundred feet in depth. Beyond this there is a rapid slope to a depth of some seven thousand feet in a few miles. Here the slope is as steep as Mount Washington, in New Hampshire, and this marks the seaward margin of what is called the continental shelf, a feature common as a fringe to several continents.

The cause of this shelf is not known. There are some who suppose that it marks the border of the continent at a time when the land was more elevated than at present—that the shore line was then near here. As evidence of this, one may point to the fact that on this shelf there are valleys, resembling river valleys, and that these seem continuous with the larger rivers of the land. There are such valleys opposite the mouth of the Hudson, in the Gulf of Maine, and on the shelf to the eastward of the mouth of the St. Lawrence. On the other hand, there are some who believe that the shelf is built up by the denudation of the land, sediment being carried to this point and no farther by reason of the presence of the Gulf Stream, which bathes the margin of the shelf and prevents the sediment from being carried farther. Of these two theories, there seems more reason in favor of the first than the second.

Continuing our cross section seaward, we come to the great ocean valley which descends to a depth of from eighteen to twenty-five thousand feet, and even more in parts of the ocean. There are here some ridges, possibly mountain chains beneath the water, and there are between them valleys; but in the ocean there is a marked difference in topography from the land, because of the absence of erosion. Deep, narrow valleys and sharply defined peaks are absent except in very rare cases, where other causes are in operation. The most common diversity in the monotony of the deep sea planes is that of volcanic peaks, which, though rare, when the whole area of the ocean is concerned, are in certain regions very abundant.

It is probable that the Bermudas are a coral-capped volcanic cone, as undoubtedly are many of the atolls of the southern Pacific. These peaks often rise from great depths with a wonderfully steep slope, often continued thousands of feet above the surface of the sea, and in plain sight of some high volcanic peaks the sounding line may indicate a depth of twenty thousand feet. If the ocean could be made to disappear, the topography of the oceanic valleys would be unique indeed.

The distribution of temperature in the ocean is interesting also. Upon the surface there are warm currents extending from tropical to temperate and even Arctic regions. These, of which the Gulf Stream may be taken as a type, follow a general elliptical course, flowing northward from the equator and crossing the ocean, then turning southward again. In the opposite hemisphere the circulatory motion is reversed. In the northern hemisphere the currents turn to the right, in the southern hemisphere to the left. There are also some cold currents extending from the cold oceans toward the warmer ones.

In the North Atlantic the Gulf Stream bathes our eastern coast, skirting the margin of the continental shelf until in about our latitude it turns across the ocean. The cold Labrador current skirts the coast line inside of the margin of the continental shelf and becomes lost as a surface current in the Gulf of Maine, but as a submarine current its influence is felt for some distance to the south.

The influence of these two currents is not confined to a modification of the climate of the neighboring ocean and shore, but is also felt in a marked degree upon the sea floor itself. On the inner coastal shelf the temperature is variable, being colder in winter than in summer, the changes being in part due to the local changes, in part to the effect of the cold Labrador current; but on the margin of the shelf the temperature rises because of the influence of the Gulf Stream.

Continuing seaward, when the greater depths are reached, where the effect of the Gulf Stream current is not felt, there is a decrease in temperature, until in the great ocean abysses an Arctic cold is encountered. There is no reason why this should be so in the condition of the ocean itself, and it must be the result of a submarine transfer of cold Arctic waters. Cold water sinks and warm water rises, and as these two opposite conditions are present, the one in the polar, the other in the tropical regions, there are good reasons for believing that such a transfer is actually going on.

As there are variations in temperature and in depth, there are also variations in the character of life in the ocean. Vegetable life is confined to the narrow zone of the immediate vicinity of the coast line, but animal life, contrary to the early belief, is abundant in the deep sea as well as on the shore line. Contrary to what one would naturally expect, its distribution and variation depends upon temperature rather than depth. As on the surface, both in the sea and on the land, animal life is more abundant in the tropics than in the polar regions, so, also, life is much more abundant in the warmer parts of the deep sea than in the cold abysses, and it is the temperature rather than the depth which governs the abundance. Thus, on those parts of the coastal shelf bathed by the Gulf Stream a luxuriant fauna is found, while in neighboring areas, both at the same or greater or less depths, the abundance of life is much less great.

The early belief in the barrenness of the deep sea was based upon the assumption that these great depths were not penetrated by sunlight, not even by the faintest glimmer of light, and that the pressure of the overlying water was immense. These assumptions were correct, possibly with the exception of the belief that not even a gleam of light penetrated to the ocean bottom. We know now, from a study of cave animals, that living creatures can accustom themselves to even absolute darkness, so that the absence of light is in no sense an insurmountable obstacle to the existence of life on the ocean bottom.

As for the effect of pressure, the fact was strangely overlooked that pressure is not an obstacle to living, provided that the pressure is distributed throughout the body. There is a pressure of fifteen pounds to the square inch upon every part of our body, but since this pressure is applied to all sides and to every molecule of the body from all directions, its effect is neutralized, and we are not aware of its presence unless we are told, or unless we rise rather rapidly to some elevation, when the pressure is removed from outside and the inside pressure gives us pain, and even causes the skin to crack. Or if we place our hand upon the cylinder of an air pump and withdraw the air from beneath, the weight of the column of air above immediately becomes painfully apparent.

It is just so with the denizens of the deep. They swim about with as much ease as their relatives upon the ocean's surface, notwithstanding that there is pressing upon them a weight of many tons to every square inch. Remove them from their home and raise them to the surface, and they experience the same results that an aeronaut experiences when he ascends to the upper strata of the atmosphere, except that it is a vastly more powerful effect. This is why deep sea fishes come to the surface with their eyes protruded from their heads, their air bladders extending from their mouths, and even their skin broken open.

As for the character of the life on the ocean bottom, it includes practically all of the varieties with which we are familiar on the surface, excepting the mammals and large fishes. It is possible that large fishes are present also, for the dredge which is used would scarcely capture a large and active fish. There are branching corals and star fishes, shells and crabs, and swimming fishes, and many other varieties of animals. Some of them are very unique in character and quite unlike the fishes on the surface. A peculiar feature is that, although some are without eyes, the greater number have well developed eyes, and since nature rarely supports useless organs, it is fair to assume that there is some light even in the ocean abysses. Whether this is a faint gleam of the sun's light, or whether it is phosphorescence, is impossible to say; perhaps both. That phosphorescence is present is shown by an examination of the deep sea creatures at night, when they glow with the ghost-like light with which all dwellers by the sea are familiar.

It is interesting to inquire what the character is of the deep sea floor, and whether there is anything like it in the rocks of the continents. Beyond the limits of the effect of the shore line conditions, the deep sea deposits are peculiar, and there is in the stratified series of rocks nothing resembling it, except the rare deposits of chalks. It is therefore fair to assume that few parts of the continents have ever been deep sea, though all parts have been beneath the sea, and this being the case, it seems likely that few parts of the real abyssal depths have ever been dry land.

Upon the coastal shelf the sea floor is composed of transported fragments from the land, and the ocean bed is sand and mud of this origin; but, beyond a rather narrow zone of a hundred miles, the ocean floor is composed of the remains of animals, rather than of rocks. There is a rain of tiny shells mingled with the larger skeletons of greater animals continually falling from the surface and accumulating on the ocean bottom. Because of the predominance of a tiny shell belonging to a species of the lowest group of the animal kingdom, the Foraminifera, their accumulation is known as globergerina ooze. It is a blue mud which, examined with the microscope, is found to be composed of fragments and complete shells of this almost microscopic creature. Countless millions of them may be found in an area of a few square feet, and at the rate of their accumulation it would take many years to form a deposit of a foot in thickness; yet the chalk of England, attaining a thickness of many score of feet, is a deposit of the same character and apparently of the same origin.

In still greater depths, that is, in the very deepest abysses of the ocean, there is a different kind of deposit, known as the red ooze, a reddish, impalpable mud, evidently the residue resulting from the solution of particles which have dropped into these great depths where the water, under such great pressure, has a solvent power and destroys the limy shells of the Foraminifera. Such an insoluble residue must be of extremely slow formation, for not only are the sources of supply very limited, but even those materials which tend to gather here are in great measure dissolved and carried away. Those who have studied the red ooze affirm that its composition indicates that the dust from meteoric showers is an essential constituent, which will serve to give some idea of the extreme slowness of its accumulation.

In various parts of the ocean depths there are slight variations in character of life, of temperature or of sediment, but the above will serve in general to indicate the main characters of the ocean bottom. Many interesting local problems have been solved and many opened for solution by the exploration of the deep sea, but although the great amount of exploration which has been engaged in by various expeditions has revealed to us many new features, there is no part of the earth's surface which is so little known, and which offers such rich rewards to the explorer.

THE Rialto at Venice, designed by Michael Angelo and erected in 1588, has a single span of 98 feet, with 33 feet rise.

MOUNT ORIZABA, OR CITLALTEPETL.

By J. T. SCOVELL, Terre Haute, Ind.

THE central portion of Mexico is a plateau from 3,000 to 8,000 feet in elevation. About 19° north of the equator a broad belt of this plateau is composed of volcanic formations, which culminate in the snow-clad peaks of Citlaltepetl, Popocatepetl and Ixtaccihuatl.

Citlaltepetl stands on the eastern margin of the plateau, about 80 miles from the coast, its eastern slope rising from the gulf, the others from the plateau.

Orizaba, the name of a city on the eastern slope, is the name by which the mountain is best known to foreigners, but, seen from a distance, rising far above all surrounding peaks, with its crown of glistening snow, the Indian name of Citlaltepetl, star mountain, seems singularly appropriate.

Popocatepetl, smoking mountain, and Ixtaccihuatl, woman in white, rise from the plateau about 100 miles west of Citlaltepetl. These old volcanoes, with Mount St. Elias in Alaska, are the culminating points of North America.

Citlaltepetl, situated just within the northern boundary of the torrid zone, rising from tropical waters to polar snows, presents within narrow limits an epitome of the earth. On the slopes of this mountain may be found every variety of surface and every kind of climate; they produce all classes of vegetation and afford a congenial home for all sorts of animal life. This region, with its wonderful variety of scenery and its myriad forms of life, is of special interest to the student of science, whatever his department.

In July, 1891, a party consisting of W. S. Blatchley, of Terre Haute, Ind., entomologist; Henry E. Seaton, now of Cambridge, Mass., botanist; A. J. Woolman, of South Bend., Ind., icthyologist; U. O. Cox, of Mankato, Minn., ornithologist, and the writer, visited the eastern slope of Citlaltepetl, making interesting collections of the varied forms of life which abound in that region. We found some forms new to science; found some familiar forms in unexpected localities; saw many interesting things, making the trip an interesting and valuable one to us. The different members of the party have published, or are preparing to publish, accounts of the work done in their several departments.

There is considerable discrepancy among observers as to the elevation of these Mexican mountains. Until recently Popocatepetl has been considered the highest elevation, but determinations made within the last three or four years show that Citlaltepetl rises considerably higher than its rivals further west. Dr. Franz Kaska, using mercurial barometers, made the elevation 18,270 feet. Professor A. Heilprin, using an aneroid barometer, adjusted by a mercurial, and estimating his station as 120 feet below the true summit, made the elevation 18,205 feet. My aneroid made the elevation, estimated at 120 feet, only 86 feet. Making this correction, the elevation would be 18,171 feet. Mr. O. G. Bunsen, C.E., of the University of Texas, and the writer, using railway levels to 8,313 feet, carried a line of spirit levels up to 14,000 feet, then using our aneroid barometer, made the elevation 18,179 feet. In April, 1892, by triangulation from the 13,000 feet level of Bunsen and Scovell, I made the total elevation 18,314 feet. These results, arrived at by different methods, seem closely confirmatory. Popocatepetl is about 700 feet lower than Citlaltepetl, and Ixtaccihuatl is about 700 feet lower than Popocatepetl. In a paper before the National Geographical Society, Dr. Mendenhall gave the elevation of Mount St. Elias as 18,010 feet, so that Mount Orizaba seems to be the highest elevation in North America.

In this region the summer is a wet season and the winter a dry one. In the sunshine it is generally hot, summer or winter, even on the upper slopes, but in the shade or at night it is usually cool and pleasant, anywhere between 4,000 feet and 10,000 feet. In summer the northeasterly winds seem to prevail, as shown by the fact that a tract of country, about fifty miles wide, to the southwest of Citlaltepetl, was dry and dusty, receiving only an occasional shower, while on either side of this region it rained almost every afternoon. The explanation seems to be that the winds from the northeast, losing their moisture on the mountain, flow over the region to the southwest as dry winds. Above the elevation of 12,500 feet, there were evidences of westerly winds, as leaning trees, drifting sands, more abundant vegetation on the eastern side of rocks, etc. But the winds most noticeable, summer and winter, were cold winds down the mountain at night, and warmer winds up the mountain by day. There is in general no rainfall during the winter; during the summer it is scanty from the coast up to 1,500 feet, then plenty of moisture to the summit, except on the southwest above 8,000 feet. The rains on the lower slopes are represented by snows on the upper slopes, but, while it rains almost every afternoon below, the snows above are less frequent, sometimes eight or ten days passing without a storm. But snow falls often enough during the summer to keep the peak covered down to about the 14,000 feet level, forming a distinct snow line. If for a few days no snow falls, the old snow melts, and the snow line rises, while an exceptional storm may carry the snow down to 11,000 feet feet or below, but 14,000 feet seems to be about the average level of the snow line. As the dry season comes on, the snowfall gradually ceases, and the snow that has accumulated during the summer rapidly disappears under the heat of a tropical sun; rocky ridges and loose sands appear on the south and east, while an extensive glacier is disclosed on the north and west. The glacier on the southwest extends downward to about 16,250 feet, narrow tongues of ice reaching 400 or 500 feet further downward, while on the north the main body descends nearly to 15,000 feet. In April, 1892, near the close of the dry season, the snow had disappeared and the ice had retreated some distance, leaving a valley or series of basins between the glacier and the crest of the moraine. In these basins were streams and ponds of water, small bodies of ice and broken rocks. The moraine is from 100 to 300 feet high on its outer face, and from nothing to 15 feet on its inner slope. The moraine is as steep as loose rocks will stand, but the rocks composing it are by no means loose; they are bound together with ice. The ice is continually melting from the outer face of the moraine, but the mass is practically constant, apparently supplied by water from the melting glacier above. Water from the glacier sinks slowly into the moraine, becoming ice again;

later it melts from the face of the moraine and is absorbed by the rocks and sands below, without forming streams. I only saw one instance of a stream across the moraine, and it soon disappeared in the porous rocks. Dry drainage channels indicate that sometimes there is water enough to form streams, but, in general, there are no streams above 12,000 feet, and those below are few and small, on account of scanty rainfall and porous rocks. While it snows frequently during the summer, the total amount does not seem to be very great. The slope on the north is more gradual, so that the glacier on the north, measured along the slope, is about five miles long, while on the west it is not more than two miles in length. The width is from eight to ten miles, and the thickness or depth from 10 to 50 feet. I found no polished bowlders or striated rocks, the only evidences of motion were occasional crevasses, and the interval between the moraine and the ice. During the summer the glacier probably advances to the moraine, and both are generally covered with snow, but, on a photograph of the peak, taken from an elevation of about 13,700 feet, August 2, 1891, after eight days without snow, the moraine can be seen as a sort of terrace across the slope of the mountain, while on July 28 and 29 it was entirely hidden by snow. The fact of the glacier on the west and north seems to indicate that more snow falls on those slopes, and that the moisture from which it is formed comes from the west. But the moisture might come from the gulf, and the snow formed on the east be carried to the western slopes by the wind. From the storms I saw, I judged that the snow was somewhat equally distributed over the mountain, whether the storm was westerly or easterly, and that the glacier on the north and the naked rocks and sands on the south were due to the fact that more snow melted on the south, rather than that more snow fell on the north.

At first I felt sure that the glacier had its source in the Pacific Ocean, but the more I investigated the matter the more I inclined to the view that much of it might have come from the gulf. These glaciers are not very extensive as glaciers go, but they present many interesting features for study, and they are easily accessible. One can ride to the foot of the moraine with little danger or fatigue. And there is little or no danger attending the exploration of the glacier beyond the physiological effects of the great elevation. From January to the middle of April the glacier may be seen at its best. No danger from snow-slides or avalanches, and crevasses are not numerous or extensive, and can be easily avoided. In summer there are occasional snow-slides on the western slope, and after 10 A. M. on a clear day there might be some danger from snow-covered crevasses, but earlier the frozen snow forms a safe bridge over any crevasse there may be in the glaciers of the Star Mountain.

Ice is quarried from the glacier for domestic use in the surrounding towns. The ice is taken out and dragged to the foot of the moraine and there loaded on burros or horses for transportation to the lower slopes.

GEOLOGY.

Citlaltepetl, Sierra Negra and Sierra Colorado are the culminating domes of a great mass of volcanic rocks, which forms part of the eastern boundary of the famous valley of Mexico. This mass, about 50 miles in diameter at the 8,000 feet level, rises by gentle slopes to the 13,000 feet level, above which rise the peaks mentioned. Citlaltepetl, the highest, is somewhat cone-shaped, but Sierra Colorado and Sierra Negra are ridges trending east and west, each about a mile in length. Sierra Negra is about five miles a little west of south from Citlaltepetl, and Sierra Colorado is about three miles southwest of the same peak.

From the summit of these peaks down to the 8,000 feet level trachytes, basalts and scoriaceous rocks seem to make up the bulk of the mass. Then there are 200 or 300 feet of cretaceous limestone in nearly horizontal strata, then from 800 to 1,000 feet of Jurassic limestone, whose crumpled and folded strata remind one of the folded rocks of Arkansas, thence down to about 4,000 feet there are several alternations of basaltic rocks and carboniferous limestones. Near the city of Orizaba the limestone is thick-bedded and associated with beds of quite good marble and beds of the famous Mexican onyx. Below the city there are Devonian limestones, then carboniferous strata to about 2,500 feet, then cretaceous to the coast sands, about 25 miles from the gulf. I noticed the succession of rocks, but did not attempt to identify the limestones; I name them as identified by Mr. Hugo Finck, of Cordoba.

According to Mr. Finck, the different phases of the glacial, Champlain and terrace periods are well marked in this portion of Mexico. The valleys of Orizaba and Cordoba were occupied by glacial lakes, over whose beds were deposited several hundred feet of drift materials, and the bowlder-strewn region below the valley of Cordoba seems to indicate glacial or iceberg action.

The interstratification of volcanic and carboniferous rocks seems to indicate that this region has been a center of volcanic energy for several geological ages, and that the limestones mentioned occupy a comparatively narrow space along the slopes of a great core of volcanic materials.

Of the peaks mentioned, Sierra Colorado has an elevation of about 14,000 feet, has a smooth, uniform outline, and the greater portions of its outcropping rocks are of a reddish color. I saw no indications of a crater. Sierra Negra has an elevation of about 15,000 feet, with a uniform surface, broken only on the south, where the old crater was situated. The southern or outer wall of the crater has been broken away, leaving the inner or northern wall as an abrupt and rugged section of the otherwise uniform slopes of the mountain. The outcropping rocks are dark basalts.

Seen from a distance, especially when covered with snow, Citlaltepetl seems quite symmetrical, but in winter, or on careful inspection in summer, great ridges of rock may be seen leading up, like giant ribs, from all directions quite to the summit, giving the peak a rugged, restless appearance, so different from the restful outlines of its less elevated neighbors.

The crater of Citlaltepetl occupies the whole summit. It is somewhat elliptical in form, measuring about 800 from north to south by 600 feet from east to west, with a depth of between 400 and 500 feet. The rim is nearly horizontal, the difference in level between the highest and lowest points being about 80 feet. The peak is a little steeper on the south than on the north, the slope being between 30° and 35° on the south, increasing toward the summit. Inside the crater, for 30 or 40 feet the slope is about the same as outside, then about 200 feet of vertical walls, then a sharp talus to the center.

The hot sunshine by day and the intense cold at night, with plenty of moisture during a large part of the year, result in rapid disintegration of the crater walls, cutting down the rim, and filling up at the bottom with fragments from the crumbling walls, so that, geologically speaking, the crater can exist but a short time. The ruggedness of the slopes and the fact of a crater seem to indicate that the peak is of recent formation. Citlaltepetl has a hot top, at least great areas of the rim of the crater are hot, giving off steam and gases, and large quantities of rocky material at the summit are the product of this fumarole action. Sulphur is found in considerable quantities in the rim of the crater, but I saw no evidence of sulphur gases, or anything to indicate that sulphur is being deposited at the present time. While there are many evidences of the recent formation of this cone, there is no evidence of an eruption of lava within historic times.

Between 8,000 and 12,000 feet we saw no rocks, the mountain was covered with a thick mantle of finely pulverized volcanic material, in some cases a black sand, then a sand of lighter color, again it is clay, that frequently appears like rock, called by the Mexicans tepetate. This deposit rises to about the same elevation on Popocatepetl, and to a height of 10,000 feet on the Toluca Mountains west of the city of Mexico, and in some places it constitutes the rim of the valley of Mexico. The proposed tunnel for the drainage of the city and valley of Mexico is being dug through the tepetate, where it is at least 300 feet deep. The material was evidently deposited from water. It seems to indicate a more extensive lake system than now exists, and possibly more rapid erosion. The presence of this deposit at such high elevations seems to indicate an upheaval of some 3,000 or 4,000 feet within comparatively recent times. The geology of this region may not be very complicated, but fossils are not abundant, and there will doubtless be many conflicting opinions among geologists in regard to many of the geological features, yet the geologist who works up the region carefully will find an immense amount of very interesting geological material within a very limited area.

LIFE ON CITLALTEPETL.

With its base in the torrid zone and its summit in the region of perpetual snow, the eastern slope of Citlaltepetl produces almost every variety of vegetable and animal life. From the coast up to the 1,500 feet level, the country is practically a steppe; rainfall limited, soil sterile, vegetation scanty, except along the streams; birds, insects, lizards, etc., abundant, with but few mammals.

The region between 1,500 and 6,000 feet is the life center of this slope, the rainfall is abundant, and the soil composed of the debris of volcanic and limestone rocks, is exceptionally fertile, producing a vegetation of great variety and luxuriance. The forest trees are seldom large, but they exist in great variety, bearing ferns, orchids, bromelias, and other plants in great profusion on their trunks and branches; and every spot not shaded by the forest is crowded with a rank growth of herbaceous plants.

While in Cordoba, at an elevation of about 3,000 feet, I met a man from New York, who was buying Mexican lumber for the inside finish of his house, and went with him out to a little saw mill, where there was not more than 2,000 feet of lumber in stock. From this small quantity sixty-five pieces were selected, and, on counting, the man found he had forty-one different kinds, all valuable as finishing lumber. It is said that there are as many as 100 different kinds of trees on the slopes of Orizaba that are valuable for lumber, besides many that furnish valuable dyes, oils, or gums.

This region is also famous for its orchids and ferns. I saw in Cordoba a collection of seventy species of native orchids, and was told that the collection did not contain nearly all the species of the region. Mr. Hugo Finck has sent to the Kew gardens from this region more than fifty species of ferns that were new to science. In this region are cultivated cotton, sugar cane, coffee, pineapples, bananas, oranges, lemons, wheat, corn, potatoes, and many other interesting and valuable plants. The markets of Orizaba, at an elevation of 4,000 feet, displayed the most extensive variety of vegetables and fruits I ever saw in one collection. In this region there were many beautiful birds, with some mammals and reptiles, but, after plants, insects were perhaps the most interesting zoological features of the locality. Professor Blatchley, in eleven days' collecting, took 160 species of moths, 145 of butterflies, 125 of coleoptera, 60 of hemiptera, and 40 of orthoptera. Other kinds of insects were numerous, but no collections were made of them. (See *Entomological News*, May, 1892.) From 6,000 feet upward the character of the different kinds of life changes rapidly, and the numbers of individuals and the variety of species are greatly diminished. In two days' collecting at 8,000 feet, Professor Blatchley only took about a dozen species of butterflies and beetles, and other forms of life seem to diminish in numbers quite as rapidly as the insects. Birds were an exception, for they were as numerous and varied at 8,000 feet as below.

Above 7,000 feet the different forms of life were more like those of the northern zones. There were oaks and elders, mustards, plantains, chickweeds, dock, violets, and familiar ferns; sparrows meadow larks, blackbirds, crows, woodpeckers and humming birds were common, along with many unfamiliar forms. But while vegetation was abundant, there were no forests similar to those so common in the temperate zone.

Pines are common from 6,000 feet upward, but the forests of pine and spruce begin at about 9,000 feet, thinning out above 12,000 feet, so that the forest scarcely reaches 13,000 feet, although in some localities trees are found up to the 14,000 feet level. Above 13,000 feet, a species of juniper spreads out over the rocks, so that at a distance it appeared like moss. Along the slopes above 13,000 feet there were mustards, compositæ, castelleias and a few other plants with two grasses, but no ranunculaceæ, claytonias, willows, or other water-loving vegetation so common on the high slopes of the Rocky Mountains in Colorado. The distribution is different in the two localities. On Orizaba individuals of the same species are seldom in groups, while on the other mountains great areas are often covered by one species. Near the 14,000 feet level, at the foot of a cliff looking east and south, where there was an indication of moisture, we found fourteen or fifteen species of plants, some of which had not been seen elsewhere above 12,000 feet. Only four species extended to any distance above this cliff. They were a castelleia and a draba, both nearly stemless, and scattering bunches of two grasses, probably an agrostis and a bromus, and these were passed at about 15,500 feet. The oaks stopped abruptly just above 9,000 feet. The ylite tree, whose thick bark furnishes a valuable dye, stopped as abruptly just above the 11,000 feet level.

A thistle, with a large white blossom, was seen only above 13,000 feet. Others again, as the castelleia, had a wide range, gradually diminishing in size as the elevation increased. Between 8,000 and 9,000 feet there were nearly as many flowers in April as in July, while above 9,000 feet in July we found nearly seventy-five species, but in April scarcely a half dozen were found, of which the castelleia and draba were two. In the regions below, flowers were much more abundant in the summer, though more orchids and some other plants bloom in the dry season. So that whether one visits Citlaltepetl in summer or winter he will find the plant life interesting and well worthy of consideration. Insects were found up to the 14,000 feet level, and I saw two white butterflies at the summit, but the number of species found above 9,000 feet were very few. Between 8,000 and 9,000 feet there were some familiar birds, but above and below these levels most of the birds were peculiar to the locality. There seemed to be several species of humming birds and many others with highly colored plumage, but we heard no songs more beautiful than we hear in temperate zones.

Sparrows were common up to 14,000 feet, and I heard one while on the summit, but whether he made his home there or was only a visitor like myself, I could not tell. Woodpeckers were busy about the trees between 13,000 and 14,000 feet, and several other birds were seen and heard at that elevation.

The rainy season was not favorable for collecting birds, but Professor Cox secured some very interesting specimens. Among reptiles, lizards were the most common, and they seemed just as lively near the 14,000 feet level as on the coast sands. Salamanders were found near the 14,000 feet level and at other localities on the slope, toads and tree toads were seen, and collections of snakes were seen, but no live ones were taken by the party. Lizards are much more abundant in the dry season. I took more in three hours one day in April than the whole party saw in fifteen days in July. We saw rabbits, had mice in camp at 12,000 feet, saw evidence of moles, ground squirrels, and other burrowing animals. Saw tracks of antelopes and coyotes above 14,000 feet, but mammalian life did not seem to be abundant. Fish are abundant in the streams of the dry season, but during the wet season the streams are muddy torrents, containing but few fish and it is almost impossible to do successful fishing in such rapid streams, so that but few species were taken. Those taken were interesting, some of which are probably new to science. The predominant forms of life were plants, insects and birds.

Professor Seaton collected over 500 species of shrubs and herbs between the 3,000 feet and 14,000 feet levels, and made many interesting observations as to the distribution of plant life within those limits and the families and genera most abundantly represented by the flora of Orizaba (see Proceedings Indiana Academy of Science, 1891). The vegetation, insect life, and birds were all we expected, but serpents, tarantulas, scorpions, centipedes, and the like, so common in pictures of tropical life, were seldom seen. We found the zoological altitude zones somewhat like the latitude zones, but with interesting variations, the details of which will be brought out fully in the reports from the different members of the party.

THE ASCENT.

The ascent of Citlaltepetl is neither difficult nor dangerous. Leaving Vera Cruz or the city of Mexico by the morning train, one reaches San Andres early in the afternoon, then by tramway, about six miles, to Chalchicomula, a little town of some 3,000 people situated on the western slope of the mountain at an elevation of about 8,300 feet. At this place, guides and horses may be engaged and other preparations made for continuing the ascent next day. A ride of six or seven hours over a steep but fairly good road for horses takes one to a cave, at an elevation of about 13,700 feet, where camp is usually made for the second night. The work of the third day is severe, and preparations should be made for a good breakfast and an early start. These items must be looked after by the tourist himself, as the guides are in no hurry, and an ordinary Mexican breakfast would not do for an American or Englishman who has a day of hard work before him. Starting early on the third morning, one rides to the foot of the moraine, near the 16,000 feet level, above which the slope is too steep for horses, and the real work of the ascent begins.

The ascent from this point is made along a ridge which forms the eastern boundary of the glacier. In the dry season the tourist climbs slowly upward over rock and ice without danger, except such as may arise from severe exertion in the rarefied air of such great elevations.

In the wet season the rocks and ice are more or less thickly covered with snow, which necessitates precautions not called for during the dry season. The eyes should be protected by colored glasses, and the face by a thick veil from the heat and light reflected from the snow, and the feet should be wrapped in coarse cloth to protect them from cold and to prevent slipping on the crusted snow. The chief guide leads the party, cutting steps in the snow for himself and followers. One might miss his footing and slide to his death on the rocks below, but the danger is not great if the instructions and example of the guide are followed carefully. It requires considerable exertion to climb steep slopes at low elevations, but when the elevation is so great that nearly or quite half the air is below, the least exertion is exhausting. The lungs can get oxygen enough to supply the system when at rest, and one may ride from the sea level to the 16,000 feet level without discomfort from light air. Above 16,000 feet,

one not accustomed to the air of such elevations can climb but a few feet before sinking down in utter exhaustion, gasping for breath, with palpitating heart, oppressed brain, and possibly a qualmy stomach. After a brief rest the unpleasant symptoms pass away, then a little climb, then a rest, and so upward, the climbs getting shorter and the rests longer till at length the summit is reached. Some can climb faster than others; a good rule is to climb so far as possible without opening the mouth to breathe, then rest. On the average, one does well to climb 500 feet an hour.

Edward Whymper speaks of a "mountain sickness" which affected him and his assistants while exploring among the high Andes. Some of us had a little nausea, but we did not attribute it to the rarefied air, and Mr. Bunsen had a severe headache while on the summit, which passed away soon after the descent began, but none of the party was affected with the mountain sickness of Whymper. No other locality on the globe affords such a full and comprehensive panoramic view as does the eastern slope of Citlaltepetl, whether seen from shipboard some 20 or 30 miles at sea, or from the summit of the mountain. The view from the summit is clearest during the forenoons of the wet season, when the air is free from dust and usually clear. During the dry season a dust or haze pervades the air to an elevation of 9,000 or 10,000 feet, so that objects below that elevation cannot be distinctly seen.

The descent is made to the cave or to Chalchicomula for the night, and Vera Cruz may be reached on the fourth day; thus practically making a journey from the tropical to the polar region and return in four days.

A PORTRAIT OF MEISSONIER BY HIMSELF.

Nowhere else on the earth can this be done as easily, quickly, and safely as on the eastern slope of Citlaltepetl, the Star Mountain of North America.—*Science.*

MEISSONIER'S WORKS IN LONDON.

THE present exhibition at Messrs. Tooth's gallery well deserves the attention it is likely to attract during the very short period that it remains open. Besides many hundred small preliminary studies, it contains several of the best of Meissonier's finished pictures, and although etchings and engravings have made the subjects of most of them familiar to the public, with very few exceptions they are now shown in London for the first time. The most famous of the artist's works, "La Rixe," is lent by the Queen. This is dated 1855, and as regards mastery of design, intensity of expression and dramatic force of realization, he has never surpassed it. Of many pictures showing his knowledge of military matters, the "Portrait du Sergent" is one of the best. The soldiers of the first empire period watching an artist sketching in a barrack yard are true and distinct types of character, natural in their movements and lifelike. Meissonier's remarkable faculty for seizing unconscious phases of expression and gesture is again shown in the eighteenth century scene, "Le Peintre d'Enseignes." These works belong to his best period, and are painted with masterly firmness and expressive certainty of touch, but they fail to convey an impression of outdoor light. The very small interior, "Les Joueurs d'Echecs," will find many admirers by reason of its fullness of detail and elaborate workmanship, but the figures want vitality, and the prevailing color is rather lurid and oppressive. Unlike this, "Graveur à l'Eau-forte"—a young etcher engaged in his work beside a garret window—is remarkable, among other good qualities, for its broad illumination and bright but delicately modulated color. Excellent as works of art as well as interesting in subject are Meissonier's two small portraits of himself. One represents him as a man of middle age, with his pipe in his mouth and his favorite dog, Roubra, lying by his feet; and in the other—painted some years later—he is seen in a crimson dressing-gown, and with another dog beside him, seated with a deeply contemplative expression on his face. The full length of the burly "Charles Quint" standing in defiant attitude, and the more sketchy study of a fat but comely "Aubergiste," with a bottle in her hand, are admirable renderings of character; but the most expressive of the single figures, and in every respect one of the best, is the small water-color "Le Soupçon," showing a seventeenth-century cavalier, with cloak wrapped about him, listening beside a door with a look of earnest watchfulness on his face. The last important work which Meissonier produced, the battle of Iéna, "1806," and the very large water-color, "1807," both masterworks of their kind, we noticed when they were first exhibited here.—*The Graphic, London.*

THE COMMISSION OF ARBITRATION OF THE BEHRING'S FISHERIES.

OUR readers have already been posted by the daily papers as to the differences that have been pending for many years between Canada and the United States on the subject of the seal fisheries of Behring's Strait. At the end of June of last year, an arbitration was agreed upon between the two contending parties, and it was toward the end of March of this year that the commission held its first session at the ministry of foreign affairs, Paris.

The United States, in their quality of owners of Alaska and the eastern islands of Behring's Sea, which they purchased from Russia in 1867, claim, as Russia herself has always claimed, an exclusive jurisdiction over the waters of the strait, in order to protect the fur seals that are met with by millions in the Pribyloff Islands from the massacre that is now being committed by the fishing schooners of Canada. England, in the name of Canada, opposes to the claims of the United States the principle of international law that recognizes the jurisdiction of a state only within a limit of three miles from the coast.

The arbiters have, therefore, to examine what are the rights of jurisdiction exercised by Russia in days gone by in Behring's Strait, and consented to by Great Britain, whether such rights were integrally transferred to the United States by the cession made to them of Alaska and the islands, and whether, being given the very peculiar nature of the right of proprietorship and of protection of the fur seals that form the subject of the contention and that are migratory animals, the jurisdiction of the United States should be recognized and in what measure, beyond the ordinary limit of three miles from the coast, in order to assure an efficient protection to these animals.

The debates take place in the English language, and the arbiters will have to render their decision in the month following the close of the session.

The seven arbiters are: Lord Hannen, former president of the division of divorces and of the admiralty of the high court of justice, and Sir John Thompson, prime minister of Canada, designated by England; Hon. John T. Harlan, judge of the Supreme Court of the United States, and Hon. John T. Morgan, United States Senator, designated by the United States government; Marquis Visconti-Venosta, former minister of foreign affairs of the kingdom of Italy, designated by the latter; Baron de Courcel, senator and former ambassador of the French republic, designated by France; and Mr. Gregers Gram, former minister of state, designated by Sweden.

The government of the United States is represented by Mr. Foster, and that of Great Britain by Mr. Tupper, minister of Canada. Among the counsel of the two parties are found some of the most eminent lawyers and orators of England and America.

The tribunal is installed in the great dining room of the ministry of foreign affairs, Paris. The large hall adjoining is converted into a buffet at the time of each session.

Mr. Develle has endeavord to worthily receive the representatives of the two great friendly nations that have selected the capital of France for the reunion of their arbitral tribunal.

Not content with putting at the disposal of the arbiters one of the most sumptuous rooms of the palace, he has desired to treat them as pampered guests, and it is regal repasts that are served to these gentlemen during the suspension of the meetings. —*Le Monde Illustré.*

THE APPRECIATION OF GOLD.

THE relative production and value of gold and silver have varied greatly in the past. In 1493, or 400 years ago, the production was by weight only 8·1 of silver to 1 of gold, though the value of gold was then 10·7 times that of silver. Silver was undervalued, yet its market price did not increase. From 1520 to 1620 the product of silver increased enormously, while that of gold was nearly stationary; in 1600 it was no less than 56·8 times that of gold, and yet the value of gold had appreciated only to 11·8 times that of silver. Silver was then greatly overvalued. During the next 160 years the production of silver declined while that of gold steadily increased, until, in 1760, the proportions by weight were 21·7 silver to 1 gold, or not much more than one-third what it was in the year 1600; yet during this period the relative value of gold increased about 27 per cent., or to about 15 times that of silver. During the 50 years from 1760 to 1810 the output of silver again increased largely, while that of gold declined—the proportion reaching in 1810 the figure of 50·3 silver to 1 gold—but it then began to decline, owing in part to an actual reduction in the output of silver up to 1855 and in part to a rapid increase in that of gold after the discovery of the California placers in 1849. From 1850 to 1860, when the output of gold reached its maximum, the production of silver was only 4⅓ times that of gold, yet the value of gold continued to be nearly 15⅓ times that of silver, that being about the average ratio of value in coinage. From about 1670 to 1870 the value ratio of gold to silver varied between the limits of 14⅓ to 15⅓, notwithstanding the enormous fluctuations in production ratio between the limits of 4 up to 50 silver to 1 gold.

This stability in value between the metals under widely varying conditions of production was unquestionably due to the fact that during nearly the whole of that period every nation was using silver as its chief money, and the total output of the world was absorbed at the coining ratio either for coinage or for hoarding, which was practiced more generally in those days of wars and political uncertainties than at present.

In the year 1892 there was produced in the world about 30·2 times as much silver as gold, and the market value of gold was only 23·73 times that of silver; the decline having been continuous since 1860, with the exception of a rise in 1890 due to the heavy purchases of silver by the United States government under the "Sherman act." The statistics demonstrate conclusively that the commercial value of silver as compared with gold is not necessarily closely governed by their relative productions and that stability in the value ratio between the metals could be very easily maintained by international agreement, even under much wider fluctuations in relative production than could occur under the operation of the plan proposed by the *Engineering and Mining Journal*, which takes account of and adapts itself to the changing conditions and lessening cost of silver production. The statistics also seem to demonstrate the gradual decline in public estimation of the white metal, owing, apparently, in part, to its greater abundance and lessening cost of production, in part to the greater cost of its transportation and storage, and in part to the declining use of metal money in the business of the world, due to increasing facilities for distribution and exchanges of goods and money, to the greater freedom from war and greater safety of property, to the increase in knowledge and confidence between the inhabitants of the world, and to the restriction in the use of silver in coinage in Europe. No one of these causes would alone account for the great decline in the value of silver, but they react on each other until the net result is a steadily declining value for the metal, and, while these conditions obtain, the statistics disclose nothing which would justify the belief that the value of silver will increase or even be maintained.

Silver is a far more abundant metal than gold in nature, and the progress in metallurgical knowledge will probably always reduce its cost of production relatively more than it will that of the rarer metal. Moreover, the increasing wealth of the world and the need of transporting or storing vast sums increase the convenience and appreciate the value of the more precious metal.

There has unquestionably been a considerable appreciation in the value of gold, not only as compared with silver, but as measured by nearly all other products, and the fact that the production of gold has been almost stationary for thirty-five years shows that at its relative value during that period its production has not been sufficiently profitable to cause capital to embark in it except in comparatively rich mines. It seems certain that the value of gold will continue to appreciate, or, in other words, that products of all kinds will continue to depreciate in value not only because of improvements which permit their cheaper production, but because gold itself is appreciating in value owing to the demand for larger quantities of it than can profitably be produced at present value. If silver

Visconti Venosta, Italian Arbiter.

Baron de Courcel, President.

Gregers Gram, Swedish Arbiter.

Lord Hannen (British).

Sir John Thompson (British).

Ch. Tupper (British).

Sir Ch. Russell (British).

Sir Ch. Richard Webster (British).

Ch. Robinson (British).

H. Box (British).

R. P. Maxwell (British).

R. S. Ashley Tronde (British).

Ch. Russell, Jr. (British).

Mr. Piggott (British).

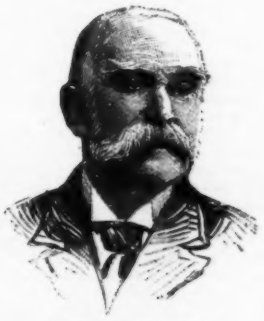
G. Pope (British).

Mr. Cunyngame (British).

John Foster (American).

J. Harlan (American).

Mr. Phelps (American).



James Carter (American).

Henry Blodgett (American).

Fred. R. Coudert (American).

William Williams (American).

Mr. Lansing (American).

Major Halford (American).

J. Stanley Brown (American).

Hubbard Smith (American).

MEMBERS OF THE INTERNATIONAL SEAL FISHERY COMMISSION IN SESSION AT PARIS.

should be demonetized everywhere, as is inevitable unless some international agreement for bimetalism or a wider use for the metal be adopted, then the demand for gold must necessarily be enormously increased, and its value will appreciate in a still greater degree; that is the value of everything, whether metals, breadstuffs, manufactures, or labor, will suffer.

Under general demonetization it is not unlikely that the entire first direct loss on silver alone might amount to 50 per cent. of the present coinage value of the silver money in the world, or, say, $2,000,000,000. And this loss would come so suddenly that it would utterly bankrupt the silver basis countries.

So long as the silver country could produce within itself what was necessary for its existence it could continue to use its silver, but no civilized country can close its gates to the commerce of the world, and yet with the heavy and fluctuating discount on exchange the silver countries could not afford to import the goods manufactured in the gold countries. Neither could the silver countries pay interest in gold on their national or industrial securities.

There seem, therefore, to be but two horns to this dilemma. 1st. The silver nations, such as India, China, South America, Mexico, etc., might continue on the silver basis and default on all obligations calling for gold, and cease to buy goods which had to be paid for in gold, which would close the factories and bankrupt the gold standard countries; or, 2d, all nations would discard silver and use only gold—which would bankrupt the silver nations, when they could buy nothing and pay no debts. Moreover, it would so increase the demand for and value of gold that it would utterly derange values throughout the world and bring irreparable injury and misery before the industry of the world had been adapted to the new conditions. Wages, of course, would decline enormously.

England is already finding her export trade declining, because the silver basis countries, unable to pay even the present exchanges, are forced to stop buying her goods, and their railroads and industrials are unable to pay interest or dividends in gold when their receipts are in silver.

The world is so narrow and knowledge so wide that no country can now prosper by a policy that bankrupts its neighbors. As the prosperity of one extends beyond its borders and enriches others, so the bankruptcy and misfortunes of one injure all. Render the finances and credit of the borrowing and consuming countries safe and good, and their increasing orders would set the wheels of industry in Europe moving with increased velocity, while their prompt payment of debts and the new fields they would open for investment would add to the wealth of their great European creditors.

The above is from the *Engineering and Mining Journal*, and that paper proposes the adoption of an international monetary clearing house plan, which it thinks would bring about improved credit; would establish on a firm and stable basis the money of the world; would prevent the undue appreciation of gold, and, while bringing incalculable benefit to all, and especially to England, would cost no sacrifice or injury to any nation.

SOL STONE'S RULE TO FIND DAY OF WEEK FOR ANY DATE IN PRESENT CENTURY.

To the *given year* add its 4th part (omitting the century (18–) and disregarding the remainder), also day of month and *ratio* of month; divide sum by 7. Remainder = day of week; 1 = Sunday; 2 = Monday, etc.; 6 = Friday; 0 = Saturday.

Ratio for June, 0; September and December, 1; April and July, 2; January and October, 3; May, 4; August, 5; February, March, November, 6.

Leap Years.—January and February are 1 less (subtracted from sum before dividing by 7). For *next* century, subtract 2 from sum. *Last* century, *add* 2 to sum. Last century but one, add 4 to sum.

E. G.: Oct. 10, 1859 $\left[\begin{array}{cccc} \text{yr.} & \frac{1}{4} & \text{ratio} & \text{day} \\ 59 + \left(\frac{59}{4} =\right) & 14 & +3 & +10 \end{array}\right]$

(86 ÷ 7 = 12 and 2 remainder: 2 = Monday.

E. G.: Xmas day, 1893. $(93 + \left(\frac{93}{4} =\right) 23 + 1 + 25) =$

142 ÷ 7 = 20 and 2 remainder: 2 = Monday. H.

THE CHINESE QUESTION.

A CORRESPONDENT of the New York *World* expresses himself as follows:

The persistency with which the United States and the nations of Europe hammered at China to make treaties with them, to open certain ports to them, to let them come to this country to live and to trade with them, and the fact that the United States went to the expense of war to compel a compliance with the terms of those treaties which China, after reluctantly granting them, would have permitted to lapse into desuetude had she been permitted to do so, very naturally gave her an exaggerated idea of her own importance and tended to confirm a feeling of superiority which had been inculcated by the attitude of the other nations of Asia, whose territory lay contiguous to hers, and by the obsequiousness of the few merchants of Europe who made their way overland into the realm of the Great Khan of Tartary centuries ago.

Feeling as they do that the friendship and commerce of China must be great prizes in the eyes of the "outer barbarism" to justify their paying such high prices to obtain them, it is not surprising that the Chinese resent their present treatment when they realize that the United States are disposed to ignore the terms and conditions of the treaties now that they have ceased to be the only beneficiaries.

To the few Chinese statesmen who really pay careful attention to the subject of foreign relations, particularly to those which concern the United States of America, the attitude of the United States at the present moment must seem very undignified, not to stigmatize it by a harsher term. They must have a supreme contempt for a vaunted civilization which does not dare meet that of Asia on even terms. In the matter of time Americans appear to be veritable parvenus in worldly progress in the eyes of the representatives of a people whose civilization attained, ages ago, when their written language crystallized into its existing form, to the condition which China had reached when Europeans, blinding, groping along out of the darkness of the middle ages, stumbled into a pathway which, by and by, led them into a condition something like that to which China could calmly look back upon in her remote past.

The presence of Chinese in the United States is the natural outcome of the terms and conditions of treaties which, at the time when they were forced upon her, the officials of this country did not seek to make—did not want—and would have abrogated had they not been forced to make a pretense of living up to the terms thereof by hostile fleets and armies whose combined strength they could not withstand.

For many years all the benefit that was to be derived from the privileges extended by the terms of the treaties inured to the people of the western powers—incidentally, of course, there was some profit to fall into the tills of the Chinese merchants, but the mass of the inhabitants were not enthusiastic and tolerated the foreigners because they couldn't help themselves. By and by, when the time seemed ripe to get the Chinese people to go abroad, it took a great deal of persuasion to induce them that they, too, might derive considerable benefit by availing themselves of the privileges conferred upon them by those same treaties. When they did realize that perhaps they might earn something more than the miserable pittance doled out to them by their employers at home or a little better living than they could wring by the hardest kind of toil from their rice fields or sugar patches if they would cross the seas to the lands of the outside barbarians, there were plenty of agents and contractors to paint in glowing colors the immense benefits to be gained by assisting to develop the resources of the Pacific coast, by building railroads and by furnishing the requisite brawn and muscle to complete hundreds of kindred undertakings.

Then it was that specious contracts were made with hundreds of unsophisticated laborers in the Kwang provinces (south and west of Canton), and that whole cargoes of coolies were shipped off from Macas to work on the Panama Railway. It is well known that the schemes employed to induce those laborers to leave their homes were simply contemptible. It is even hinted that many of them were abducted, drugged with opium to get them into a condition which would prevent their exposing the frauds, and put on board ship in utter ignorance of where they were going or what they were to do. It is equally well known that the promises made to those few who appeared to go freely and voluntarily as to the conditions under which they should live and the treatment they should receive were merely made to be broken.

The poor creatures were crowded into ill-conditioned, ill-ventilated holds of ill-provisioned, badly manned sailing vessels, and after existing in the midst of reeking filth for many months while the ship made its slow voyage across the ocean through the sweltering heat of the tropical seas, on their arrival at Panama they were tumbled out like bales of merchandise, and in spite of protests properly raised at the treatment were driven to their work almost at the end of a lash.

Many of the miserable wretches died on ship board and their bodies were tossed overboard to feed the sharks that swarmed around those death-breeding pens of humanity. This was in express violation of the terms of their contracts, which out of respect for their religious convictions expressly provided for the return of their bodies to China, where decent interment would permit of the rites of ancestor worship—dearer to the hearts of good Confucians than any tenet of the Christian religion is to the Christian.

Once at the field of labor and compelled to take up the tools, it was policy to feed them decently in order to get out of them the maximum of labor. But the climate of the isthmus is so bad that even the strong, able-bodied survivors of that terrible experience aboard ship succumbed to the attack of Panama fever as a flock of sheep dies when the "rot" has developed among them.

To seem to palliate their miseries and to make them think that perhaps their state was not quite so bad as it really was, smoking opium was served out freely to them. The constant use of the drug gave a few minutes of relief from the miseries of life in the dreams of home, but the compensation was swift and terrible and tended to hasten the work of the climate, so that in a few weeks after putting Chinese coolies to work on the Panama Railway the deaths were so numerous as to tax the resources of the contractors in getting rid of them. It is said, and probably the statement is not exaggerated, that under each end of every tie that was laid from ocean to ocean, including all switches and sidings, the contractors might have buried the body of a Chinese laborer and had enough corpses left to start a large cemetery.

Then when the time came to develop the resources of the State of California, and the whole Pacific coast agents were again sent to China to engage farm laborers and all kinds of workmen and operatives, of suitable material at anything like reasonable wages, there was no adequate supply in all the land. Again, when the contractors on the Central Pacific Railroad were in despair at their inability to get for love or money the requisite force of "navvies" in California, the persuasive voice of the employment agent was heard in the crowded districts of Southern China, and fresh thousands of the useful, tractable, industrious coolies were lured across the Pacific. The vessels of the Pacific Mail Steamship Company, and afterward those of the Occidental and Oriental Steamship Company, were fitted up to accommodate large numbers of Chinese immigrants.

All of these matters are dwelt upon at this length to show and to emphasize the fact that the introduction of Chinese labor into the United States was not, primarily, due to the desire of the government of this country to turn loose its superfluous population upon the Americans, and that if the presence of so many Chinese in America be an evil, it is one for which the Americans themselves are to blame.

But suddenly in California was heard the voice of Denis Kearny and the other "sand lotters" clamoring that the Chinese were taking the bread from their mouths and driving them out of every field of honest labor, debauching their sons and working all manner of evil. Then arose the slogan, "The Chinese must go!"

Go! Why? Who had first induced them to come? Who had pointed out to them the way to the United States? Who had sent emissaries to plead with them to overcome their conservative prejudices against leaving their native country and to hold out inducements to come?

The very people who are now loudest in their demands that every means—foul when fair ones will not answer—shall be employed to prevent more from entering America, to keep those who have acquired any rights there, but have returned to their own country for any reason, from coming back, and to drive out those who are now there.

Politics make strange bedfellows, and it is an anomalous sight indeed to see the Republican senators and representatives of the Western States affiliating with their Democratic brethren in an attempt to deprive strangers of all rights and privileges.

The Chinese are not to be blamed for having learned, and quickly, too, that there were better chances for them in America than at home, and for having taken in good faith your pressing invitation to come.

There is not an agricultural pursuit, a mechanical industry or a commercial enterprise in the State of California or the whole Pacific coast which would have attained its present proportions had it not been for the assistance rendered by the Chinese laborers. And today, despite the clamor of "the Chinese must go" party, employers of labor on the Pacific coast could not get along at all if they were entirely deprived of their services. The inconsistency of the present agitation is accented by the fact that in the homes of nearly every one of the agitators, if they can afford to keep them, there are Chinese employed as domestic servants.

Admitting, for the sake of argument, the truth of all that has been said of the Chinese being undesirable residents, impossible citizens and pernicious in their influences, the blame for all this lies with the Americans.

No one who knows aught of the conditions which existed in the Western States and Territories in the later sixties, just after the war, when labor was scarce everywhere and tremendously high priced, and who can now discuss calmly and unprejudicedly the subject of Chinese influence upon the development and material prosperity of that region, will or can refuse to say that but for the Chinese laborers the completion of the first transcontinental railway would have been deferred many years, or that there would to-day be so many different routes to the Pacific coast as there are. Possibly some of the Northern lines might have been built, although we doubt it; certainly the Southern Pacific—through Texas, New Mexico and Arizona into the lower part of the State of California—would not have been an accomplished fact, and the network of roads from San Diego on the South to Vancouver on the North, which now fills the whole territory west of the Rocky Mountains, would have still been an unrealized dream had there been no Chinese coolies available.

It was well for the men who made their colossal fortunes from the old Central Pacific that they could put their hands at once upon the cheap and effective labor of the Mongolian. Had it been otherwise they would have forfeited their rights through failure to complete the road within the statutory limit of time, for had they been never so willing to pay high wages, the laborers were simply not forthcoming. As it was, through the assistance they derived from the Chinese laborers, they were enabled to open for traffic in 1869 the road that they had been content to promise should be in operation in 1871.

When the Chinese were going freely to San Francisco—circa 1866-1876—was the time to have laid plans to prevent too great an influx, had there been any real grounds for apprehending an invasion of too large numbers. The agitators of the present movement cannot say that no warning voice was raised, for there were men at that time to say that, while in reasonable numbers the Chinese would be extremely useful, there was danger to be apprehended if they came in unlimited numbers.

Had there been some wise legislation at that time, the existing conditions might easily have been averted, or had your diplomatic representative at Peking been properly instructed, he might readily have induced the Chinese government to prevent its subjects from leaving their homes in such numbers by placing restrictions upon the issuing of permits or by any one of a dozen different ways.

The Chinese government has always been opposed to letting its subjects go away from home to become hewers of wood and drawers of water in foreign lands, and time and again the Peking officials have said: "If you will discontinue your efforts to induce our people to leave their homes, we will see that they do not go to your country unsolicited." It is probably not generally known in the United States that there are vast tracts of unimproved land in different parts of China, principally in the west, northwest and northern parts of the empire, capable of supporting the excess population of the congested districts of the south and east. It is impossible to induce the people to migrate from one part of their own country to another. The means of communication are, moreover, so inadequate that it is impossible to transport the people to these new territories with any sort of comfort, and it is easier for the people of the overcrowded districts to make their way to the eastern seaboard and thence out of the country entirely than to go to the western grazing lands or to the northern plains. When the leaven that is now working shall have induced the rulers to throw the preponderating weight of their power into the scales, the inertia of an ancient conservative and the prejudices of an excessively numerous class of literati who live upon the ignorance and superstition of the common people will be overcome. Then the development of China will take place upon lines which the rulers will find are best suited to the requirements of their own environment, although in matter and in kind they will be modeled upon those of the West. We have immense faith in potentialities of China, but we know that the people are not to be carried away by

any meretricious attempts at aping an alien civilization, nor will they be bullied into building railroads, *et hoc genus omne*, until they are satisfied that they are ready to use them.

But on the Pacific coast, where white labor was scarce and where things must be done in a rush, selfish ends were to be accomplished at any cost, and the possible fruition of the seed that was planted when the Chinese were urged to flock in any numbers was never for a moment considered. To help them row their boat they ship an alien crew; when they get into rough water and the boat is in danger of swamping they want the alien to get out! The danger that was long ago pointed out now seems to appear, and from sheer inability on the part of the people of the Pacific coast to meet in a reasonable way the situation for which they are themselves alone to blame, we are asked to consent to the drastic measures of the Geary law.

It must make the blood of any intelligent Chinese boil to study the provisions of that law and to consider the invidiousness of its bearing upon his countrymen. Particularly must this be so when he visits Ellis Island and sees the 2,000 immigrants who come ashore there each week from Europe without being subjected to a single one of the degrading restrictions that the law contemplates putting upon him and his nationals. Anthropometric data have been of great service to scientists in the study of comparative human development, the differentiation of the races, species, etc., but to apply the rules of that system of measurement to one class only in a community savors too much of prison regulations to be quietly submitted to by that one class, and the protest against such invidious action as is contemplated by the act under consideration is what we should have expected from those who have any feeling of self-respect.

We would not be understood as closing our eyes to all the undesirable features of the Chinese communities in the United States. We admit that they are not by any means what should be chosen as elements from which to mould the ideal civilization, and that there are few individuals whom we should select as the material from which to make the very best citizen, but considering them in all their aspects, we do not hesitate to maintain that there are many other communities whose elements are quite as much opposed to the spirit of American institutions.

AMERICAN INCONSISTENCY.

You have thrown open your educational establishments to the whole world and have welcomed students from all lands—China included. Some of the brightest men who have come to your colleges from the Celestial Empire—and none of these who have come for earnest study has been below the average of intellectual attainments—have devoted themselves to the study of our Constitution (we have in mind particularly a recent secretary of legation at Washington). Those men have expressed themselves as impressed with the fact that your government is based upon a breadth of foundation sufficient to carry a superstructure which shall challenge the admiration of the world in its superb detail, harmonious parts and graceful proportions. What must be the thoughts of such men when they see you willing, at the demand of a few discontents, to abrogate the very best principle of your Declaration of Independence, and to throw out the corner stone of your Constitution; to seem to withdraw from your position that all men are free and equal?

We do not know the exact money value of the permanent investments of the Chinese in the United States. Undoubtedly it amounts to a considerable sum, although there are not many single establishments that represent a large amount of capital in land and improvements. We do know, however, that the investments of your citizens in China aggregate many millions of dollars, and this fact should induce great caution in the treatment of the Chinese in your midst. Should the government of China decide to resort to retaliatory measures and issue an edict requiring all American citizens to register and submit to being measured and weighed and photographed like a lot of rogues in a gallery, you would have to submit, and by so doing lose prestige, reputation and every characteristic that a man holds dear; or you could refuse, and then there would be absolutely nothing for those who have their investments here to do but to leave the country, sustaining heavy losses either by disposing of property at frightful sacrifice or from the necessity of putting it into the hands of friends who are subjects of some other treaty power not so inimical to China as you are.

To talk of war with China over the Geary law is simply absurd. Great Britain alone could and would prevent it. Her interests in China outrank yours in value ten to one, and she has the power of persuasion which would enable her to induce China to take the insult quietly, or if she failed at that she could lend China assistance enough to keep your fleets so far from all the leading ports that her interests would not be jeopardized. There is scarcely a chance that China would try to resort to measures so foreign to her policy. If the United States persist in forcing this insult upon her, she will, with that quiet dignity which has characterized her general demeanor, submit, and you will have the satisfaction (?) you can get from the knowledge of having done an unfriendly deed.

You are much too prone to look upon China's great conservatism as an apathy which prevents her paying any attention to what is going on outside her own borders and indifferent to the treatment of her subjects in foreign lands, but therein you are fatally mistaken. There has been little of the remarkable dash and tumultuous upheaval in society in China which has characterized the efforts of her neighbor, Japan, to jump into the very front rank of nineteenth century civilization. None the less China has progressed, slowly and continuously, as she has done everything, but just as surely and cautiously as she has found advisable for her own best interests.

Her statesmen are the peers of those of America or Europe; her merchants are not to be outdone in commercial acumen and probity by any in the world; her engineers are fully equipped to take charge of any and all enterprises for the development of her vast industrial resources, and strange as it must sound to those who have not had opportunities to study her present position, she is prepared to-day to send out from her towns every alien, to shut her gates in his face, and to progress along lines which shall contribute to her material prosperity without the advice or assistance of a single foreigner. It is not likely that she will do this, but if she should, she would not to-day find the leading nations of the world ready to combine against her as they did in the early part of this century and again just after the middle. Jealousy among the foreign barbarians is China's protection, and knowing as she does that she is her own mistress now, it is not wise to hector her.

The constitutionality of the Geary law has been decided by the Supreme Court of the United States, which consented to defer its summer recess until it had heard and decided the test case.

Here are the conclusions: You forced your treaties upon the Chinese and drew them in terms that were intended to be for your benefit, rather than for the advantage of that people; you insisted upon their adhering to the terms thereof when they would have allowed some to lapse, even at the sword's point. Afterward you begged them to come to you when you needed their assistance. Now that there is threatening danger to you, you wish to resort to undiplomatic, unconstitutional methods to wipe out the mischief that you have got yourself into, and you say it is not fair or honorable.

THE LOCOMOTION OF DIATOMS.

THE study of the infinitely varied forms of diatoms deeply interests micrographers, certain of whom devote their entire life to the collection of them. Fig. 1 gives the aspect of a few remarkable species. The specification of the Diatomaceæ is beginning to be well known, but the same is not the case with their biology, certain points of which occasionally remain in complete obscurity; such, for example, is the manner in which they move about in the water. Let us recall the fact that a diatom, whatever be its form, can be very simply described. It is a simple cell formed of a protoplasmic mass containing a nucleus in its center and surrounded by a membrane. It is this latter especially that presents characteristic peculiarities. In addition to the elegant markings that it exhibits and that delight collectors, it is remarkable for the presence of a large quantity of silica which forms a most efficacious carapax. Besides, them embrane is not continuous all around the protoplasm, as happens in other vegetable cells. It consists of two parts, one larger than the other, and comparable to a box with its cover, the latter sliding with hard friction upon the former. It seems, then, that at no point of its surface can the internal protoplasm be in direct communication with the exterior. Now, it is well known that when a diatom is examined in a drop of water under the microscope, it is seen to glide along slowly, move to the right and left, turn upon itself, and, in a word, to move like a protozoan. And yet, even with long continued attention, nothing is seen that can be considered as the cause of the motion—neither contractions nor emission of pseudopods. The diatom appears absolutely inert by itself. One was therefore reduced to forming entirely gratuitous theories as to the causes of this singular motion. That which has been most generally adopted is the admission of a phenomenon of general contractility, but so subtile as to escape the eye. However, last year Mr. Grenfell found in a few diatoms fine prolongations that seemed to be protoplasmic and to which he attributed an important role in the locomotion of the alga. But this conclusion was immediately battered in breach by Mr. Jabez Hogg, according to whom these appendages have quite a simple structure: An organic matter, carbonate of lime and a little silica. They would be simple ornaments designed especially to support the external jelly that is known to exist in all diatoms. Such species are well known in the Cyclotellæ, for example, wherein they were a long time ago described. Now, we know that these spines are not contractile, and, consequently, cannot serve for progression.

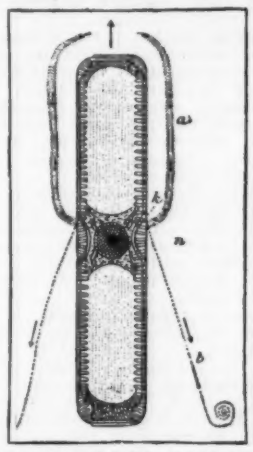


FIG. 2.—DIAGRAM OF A DIATOM (PINNULARIA NOBILIS) IN MOTION.

n. Nucleus. *a*. Current of granules. *b*. Pseudopods. *k*. Nodal point.

Recently Butschli, the illustrious professor of Heidelberg, aided by Mr. Lauterborn, one of his pupils, took up the question and reached some very interesting results. He applied himself to the study of a large species, the *Pinnulari nobilis* (Fig. 2). A simple observation does not give very definite results. We see, indeed, the diatom glide along the glass plate, but that is not a novelty. So Butschli, in order to get nearer to the bottom of the question, conceived the ingenious idea of placing under the cover glass a drop of India ink. This substance, as well known, is not soluble, but presents itself only under the form of an impalpable powder of extremely fine granulations remaining in suspension in the liquid. Now, shortly after the addition of the India ink, we observe the following phenomena: There is seen to form in the center of each valve a parcel of small granulations whose number continues to increase. Soon things are depicted more clearly: We perceive upon the front of the diatom, at the right, as well as at the left, a current of floating granulations, that flow slowly backward and finally reach the median parcel that we have already mentioned. Thence, the granules are observed to flow along an extremely fine thread which is directed backward in progressively separating itself from the diatom. Evidently, this blackish thread is nothing else than a filament, doubtless protoplasmic, so fine that it is invisible naturally, but which is rendered manifest to the sight by the granules of ink that have fastened themselves to it. Behind, the filament terminates in a free point, or else forms a spiral, as shown to the right in Fig. 2. Often, too, the extremity is broken off and blackened by the ink. The formation of the posterior filament takes place by jerks. It is seen suddenly to emerge, and to be thrown abruptly backward. At the same time, the diatom moves in the opposite direction, that is to say, forward. Then the filament seems to be retracted and thrown out anew. There seems to be no doubt that there is here a close connection between the production of the thread and of the locomotion of the diatom. This clearly explains two facts that have hitherto seemed incomprehensible. And the first is that the diatom advances by jerks, as every one has remarked who has seen these algæ alive. This explains, too, why the diatom can advance only by moving upon a solid surface. It is necessary that the filaments shall attach themselves to a substratum in order that, in relaxing, they may project the diatom forward.

This latter point is not yet positively established; it appears that certain diatoms can swim freely in water. But then it is easy to explain their progression by the

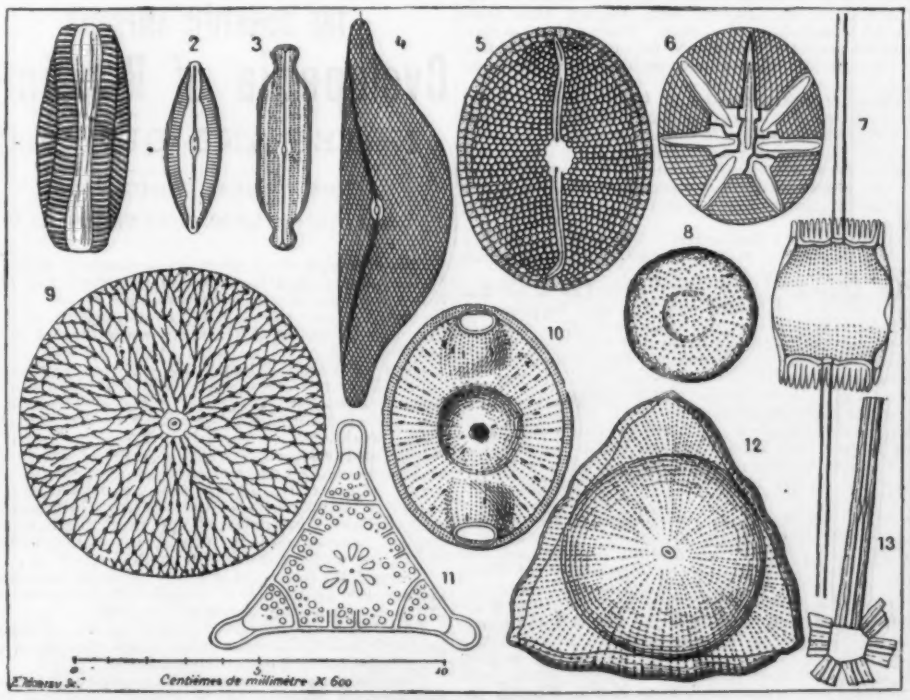


FIG. 1.—DIATOMS.

1. Encyonema prostratum. 2. Mastogloia. 3. N. affinis. 4. Toxonidea insignis. 5. O. splendida. 6. A. reticulatus. 7. Ditylium brightwellii. 8. C. proteus. 9. Coscirodiscus. 10. B. edwardsii. 11. Biddulphia venosum. 12. Ditylium undulatum. 13. Tr. fenestrata.

fact of the resistance that the liquid offers to the filaments projected backward, and that would be sufficient to cause the alga to move forward.

It is therefore demonstrated, at least for the *Pinnularia nobilis*, that the jerky motion of the diatoms is due to fine filaments that are fixed upon a solid body and that in abruptly relaxing project the alga forward. —*La Nature.*

A NEW FORM OF BAROMETER.

THE barometers used in experiments of extreme precision are generally filled by ebullition in a vacuum. This process of evacuation is so perfect that the instrument, once filled, can be set up and so placed that the mercury is submitted to a traction of more than a fifth of an atmosphere without detaching itself from the glass at the top of the tube, even when the latter has a diameter of 8 centimeters. Can a perfect vacuum be obtained without boiling the mercury? The thing appears doubtful, for glass always retains an extremely thin stratum of air, which detaches itself but slowly and may finish by exerting a measurable pressure in the barometer chamber.

However, the filling of a barometer by ebullition in a vacuum is a delicate operation, and one that is successful only in the hands of a skillful person, and it is advantageous to avoid it when the highest degree of perfection is not looked for.

A large number of barometers have been devised to this effect. That which Mr. L. Weber has just given a description of in the *Zeitschrift für Instrumentenkunde* appears to us one of the simplest and most perfect. It consists of two unequal tubes, *a* and *b*, that communicate at the upper part through a narrow tube, and at the base through a very small orifice. In order to fill it, mercury is poured into *a*, and then the instrument is inclined, while at the same time a slight pressure is exerted at *c* by means of a rubber bulb, so as to cause a portion of the mercury to pass into *b*. On causing a suction at *c*, after placing the tube upright, the mercury is made to descend a little in order to burst the bubbles adherent to the glass. Another pressure is given, and the remaining air is forced into *b*. The same operation is performed every time that

it is judged necessary. As long as the pressure in *a* is stronger than in *b*, the mercury passes directly from *a* to *b*, through the lower part, but, if one operates rapidly, the quantity of mercury that is thus forced amounts to but little. On the contrary, the communication has the advantage of permitting the mercury to fall back, so that an equality of levels is re-established in a few minutes.

Of course, the accompanying figure is merely a diagram, serving solely to show the operation of the instrument. A barometer of precision has to satisfy a large number of conditions that render it necessary to give the tube a particular form and to provide it with auxiliary parts, to describe which would lead us far from the barometer of Mr. Weber.—*La Nature.*

RICE CULTURE.

A FEW words to small farmers on this subject. Be not afraid of having land too rich, though thin land will yield something of a crop. Unless there is constant moisture, success will not be attained in a rice crop, though the plants will endure some drought when young.

Select your rice ground and keep it free of grass by often plowing till planting time. Moist land needs to be thrown into beds before planting and the rows put on the beds. Dry land needs no beds. Whether on beds or level land plant in very narrow drills, and avoid too much seed. A teaspoonful for every four feet is plenty, and if it comes well will need thinning at that.

Put rows 3½ to 4 feet apart. Plant the crop any time after the 15th of May up to 10th of June, when there is a good season in the ground.

Where moisture is permanent, June 1 is about the proper time for planting. Don't forget to plant in clean land, unless you employ new ground.

When the crop is up and in need of the plow take a sweep and run the wings so close to the little plants as to wrap up nearly all the little grass which may be showing itself. A cultivator will do equally well. Let your hoe alone if other work presses. When a second working is needed use a small twister, run it very shallow and make such a ridge to the rows as to give the grass a second wrapping up. Then, if there is leisure for hoeing, do it; if not, let the remaining grass alone.

When the heads are ripe half their length, cut the crop, which will give a good hay as well as the grain.

The benefits, as I see the matter, of planting rice late in North Florida are these: The land kept clean as directed above leaves little grass seed come up, and so the tillage is a trifle. The late planting gives the growing crop the benefit of the wet season to perfect in. Cool weather—favorable alike to the grain and the laborer—is on before the harvesting begins. And, lastly, my observation is that rice birds have reared their young and gone from North Florida before late rice is cut.

Now, as I have actually employed the plan here suggested, it is recommended with confidence.

How many will try it this year and report their success?—*W. N. Davis, in Florida Farmer.*

UPLAND RICE.

THE latest report of the Department of Agriculture on rice has the following to say on upland rice, which may prove interesting to Kansas readers:

"Upland rice is grown in Mississippi in the interior of the State among the pine regions, and is said to yield heavy crops.

"Rice succeeds fairly well in Texas, though its cultivation in that State can never compete with that of cotton. The area cultivated is situated along the coast and is very small, having been but 335 acres in 1879, the total crop being but 62,152 pounds of rough rice.

"Finally, upland rice is cultivated in Illinois and in other States north of the thirty-sixth parallel. It is said to grow in arid soils and may be sown broadcast upon clean land in April, ripening in September. Crops have been gathered averaging from twenty-five to thirty bushels of rough rice per acre. It is probable that upland rice would succeed well in some of the Middle Atlantic States, as Maryland, Delaware or New Jersey. It also might be more extensively grown upon the wheat lands of the Northwest."

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